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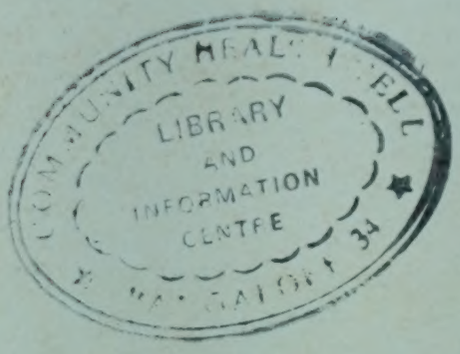
No. 1 OF 1983

ESTIMATES OF FERTILITY AND CHILD MORTALITY BY INDIRECT METHODS

VITAL STATISTICS DIVISION
OFFICE OF THE REGISTRAR GENERAL, INDIA
MINISTRY OF HOME AFFAIRS



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PREFACE

Several indirect methods of estimating fertility and child mortality have been developed in recent times. These techniques are useful especially in situations where dependable estimates of fertility and child mortality are lacking. The results obtained help in evaluating, to some extent, the data obtained from sample surveys and censuses. An attempt has been made here to estimate fertility and child mortality rates using Brass and Trussel methods for major states and for the country for the year 1978.

I wish to place on record the work put in by the staff of the Analytical & Evaluation Unit of the Vital Statistics Division. In particular, I must thank Dr. M. Holla, Joint Registrar General, Shri V. S. Swamy, Deputy Registrar General and Shri T. K. Aikat, Senior Research Officer who were associated with this report.

NEW DELHI
18th August, 1983

P. PADMANABHA
Registrar General, India

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P. PADMANABHA
Registrar General, India

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CHAPTER I

INTRODUCTION

In recent years, many indirect techniques have been developed for estimating fertility and mortality levels. These techniques are particularly useful in situations where reliable estimates by conventional methods are not available. These can also serve as useful tools for evaluation purposes by providing alternate estimates which can be compared with those already available. The present paper describes the application of a few indirect techniques for estimating fertility and infant and child mortality levels. For estimating fertility levels, one of the common methods used is the P/F method developed by Brass (1968) which in essence involves correction of the observed level of fertility by adjusting the age specific fertility rates with the help of information on average parities. Another method for estimating fertility is based on the relational Gompertz model developed by Brass (1979a). The use of this model for estimating fertility rates from average parity data has been demonstrated by Brass (1979 b). Recently, Zaba (1981) has given an extensive elaboration on the uses of this model and Kabir and Howaldar (1981) have demonstrated its use in estimating the fertility rates from average parity data for Bangladesh. For estimating infant and child mortality, Brass (1968) has evolved a technique which enables conversion of proportions of children dead in respect of women past 15 years and classified in five year age-groups into probabilities of dying before attaining certain exact childhood ages. Trussel (1975) has suggested a modified version of this method which helps to obtain alternate sets of estimates from the same data. An attempt has been made here to apply these methods and compare the estimates with those obtained from sample registration system (SRS). The basic data for application of these methods have been obtained from the Infant & Child Mortality Survey, 1979. The survey was conducted by the office of the Registrar General, India (1983) in the wake of the International Year of the Child to provide a large variety of data on infant and child mortality as well as fertility. Subsequent paragraphs provide the details of the methodology involved.

Methodology

(a) MEASUREMENT OF FERTILITY

(*i*) *Method based on comparison of life time fertility with current fertility (P/F method).*

1.1 Brass (1968) has developed a method, popularly known as P/F method which is based on a comparison of life time fertility with current fertility. The assumption involved is that fertility has not changed appreciably, as otherwise life time fertility would not be comparable with current fertility. The essence of this method is that it seeks an adjustment in the level of observed age specific fertility rates which are assumed to represent the true age pattern of fertility to the level of fertility indicated by average parity by age group of women, assumed accurate for younger women. For this purpose, the cumulated age specific fertility rates are calculated by successive cumulation of age specific fertility rates. The cumulated age specific fertility rates provide an estimate of the average number of children ever born at the end of the age groups, whereas the average parity indicates the average number of children ever born across the age groups. Hence to ensure comparability between the two, an interpolation procedure based on model fertility schedules has been devised for estimation of average parity equivalents (F values) for age groups of women from cumulated age specific fertility rates.

1.2 Brass (1968) used a simple polynomial model of fertility to calculate the relationship between average parity and cumulated fertility for successive age groups and a range of age location of the fertility model . Coale and Trussel (1974) have proposed fitting of a second order polynomial to three successive values of cumulated age specific fertility rates and estimating the average parity of women of an age group within the range by evaluating the integral of the polynomial. In the present case, the interpolation equation used is

$$F(i)=\phi(i-1)+a(i)\,f(i)+b(i)\,f(i+1)+c\,(i)\phi(7) \quad \ldots\ (1)$$

where F(i) is the average parity equivalents, ϕ (i) is the observed cumulated age specific fertility rate and f(i) is the observed age specific fertility rate for i th age group with i = 1, 2, ...6 corresponding to age groups 15-19, 20-24, ... 40-44 years respectively, and

$$F(7)=\phi(6)+a(7)\,f(7)+b(7)\,f(6)+c(7)\,\phi(7) \quad \ldots\ (2)$$

The values of the constants a, b and c were estimated by regression analysis of a large number of model cases constructed using the Coale-Trussel (1974) fertility model and are tabulated.

1.3 When age specific fertility rates have been calculated from births in a 12 months period classified by age of mother at the end of the period, there is a shift by half a year for each age group. In that case, an adjustment has to be made. This has been done by using the following relationship

$$f^*(i)=[1-w(i-1)]\, f(i)+w(i)\, f(i+1) \quad . \quad . \quad . \quad (3)$$

Where $f^*(i)$ denotes the age specific fertility rates corrected for half year shift with i=1, ...6 corresponding to age groups 15-19,...40-44 years respectively and

$$f^*(7)=[1-w(6)]\, f(7) \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

w(i) is calculated from the following relationship

$$w(i)=x(i)+y(i)\, f(i)/\phi(7)+z(i)\, f(i+1)/\phi(7) \quad . \quad . \quad (5)$$

The values of x(i), y(i) and z(i) were obtained by regression analysis and are tabulated.

1.4 From the estimated average parity equivalents (F values) and the reported average parities (P values), P/F ratios are calculated for each age group to obtain a correction factor for adjusting the level of the age specific fertility rates. The choice of a correction factor is generally recommended from among the ratios for age groups 20-24 or 25-29 years. The parity data for these age groups are expected to be more accurate as the events are more recent and parities are low. In case of older women, the data are likely to be affected by recall lapse. In this case, there is generally under-reporting of children ever born because of omission of children especially those born and dead quite some time past. In case of age group 15-19 years the number of events is usually small and hence the data are affected by random fluctuations. Because of these reasons, the P/F ratios for the initial age group or for the older age groups are not preferred for use as correction factor. The calculation of adjusted age specific fertility rates is done by multiplying the $f^*(1)$ values by the correction factor.

(ii) Method based on the use of relational Gompertz model.

1.5 The application of Gompertz model to fertility rates has been explored by Wunsch (1966), Martin (1967) and others. The advantages of this model are that it describes the age patterns of fertility by the use of three parameters and that a single transformation leads to a linear relation of fertility with age. The major limitation, however, is that the model does not give a good fit at the tails of the distribution. In view of this, Brass (1979 a) has suggested the use of a relational Gompertz model as the accuracy of the Gompertz model at the tails of the distribution can be much improved by using relational device which has proved powerful in the logit system of model life tables. Brass (1979 b) has also demonstrated the use of relational Gompertz model by applying it to Fiji data on mean parties for females of different five year age groups. More recently, Kabir and Howaldar (1981) have made use of the relational Gompertz model to study the fertility levels and differentials in Bangladesh from average parity data. Zaba (1981) has given an extensive elaboration of the relational Gompertz model which provides a simple tool for adjusting and correcting fertility distribution derived from reports of births in the last year and/or children ever born. The model can be expressed as

$$F(x)=T\, e^{-e^{-[\alpha+\beta Y_s(x)]}} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where $Y_s(x)=-\log[-\log F_s(x)]$

$F(x)$ = cumulated fertility upto age 'x',

T = total fertility rate, and

$F_s(x)$ = standard cumulated fertility up to age 'x' with $F_s(50)=T_s=1.0$

The standard series of $F_s(x)$ values has been computed by Heather Booth (1979).

1.6 Equation (6) has three parameters, viz. α, β and T. While α and β determine the shape of the fertility distribution, T determines the level. When there is omission or over-reporting of births which is not related to the age of mother, then the shape of the fertility distribution is not affected and only the level is affected. In this case, the reported cumulants upto age 50, T_R, is taken as an estimate of the total fertility. The values of

$$Y_R(x)=-\log\left[-\log\frac{F_R(x)}{T_R}\right]$$

are calculated for each reported cumulant $F_R(x)$ and a comparison of these $Y_R(x)$ values with $Y_s(x)$ values provide estimates of α and β.

1.7 Often, however, the shape of the reported fertility distribution is affected by age misreporting. The exaggeration of mothers' ages causes some births to be reported to women over 50 years which cannot be taken into account while calculating total fertility in the conventional manner. In such cases, the values of α and β can be estimated from equation (9) described later.

1.8 Zaba (1981) has also described procedures for analysing data on average parities and for comparing such data with the data on current fertility. This is described as follows. If the pattern and level of fertility are not changing over time and if P(i) denotes the average parity for the i th age group of women experiencing the fertility

schedule F(x), then a good approximation of P(i) can be found from the relationship.

$$P(i)=T\, e^{-e^{-[\alpha+\beta\, z_s\,(i)]}} \quad . \quad . \quad . \quad . \quad . \quad (7)$$

where $Z_s(i)=-\log[-\log P_s(i)]$ and

$P_s(i)$ = average parity for the i th age group derived from the standard cumulated fertility schedules $F_s(x)$.

1.9 Any decline in fertility can be examined on the basis of cumulated current fertility rates and the average parities. The procedure as indicated by Zaba (1981) is described below

$$\text{Let } y_x = -\log\left[-\log\frac{F(x)}{F(x+5)}\right]$$

$$\text{and } \phi_x(\beta) = -\log\left[e^{-\beta y_s(x)} - e^{-\beta y_s(x+5)}\right]$$

Then, for β values close to 1, $\phi_x(\beta)$ can be approximated by Taylor series expansion of the form

$$\phi_x(\beta)=\phi_x(1)+(\beta-1)\phi_x'(1)+\frac{(\beta-1)^2}{2}\phi_x''(1) \quad +\ldots\ldots\ldots$$

Evaluating $\phi_x''(1)$ for different values of x reveals that it is almost constant in the age range of $15 \leq x \leq 35$ and denoting this constant by C, the following relationship has been obtained

$$y_x = \alpha + \phi_x(1) + (\beta-1)\,\phi_x'(1) + \frac{(\beta-1)^2}{2}C$$

$$\text{or } y_x + \phi_x'(1) - \phi_x(1) = \alpha + (\beta-1)^2\,\frac{C}{2} + \beta\phi_x'(1) \ldots(8)$$

$$\text{Defining } y_i = -\log\left[-\log\frac{P(i)}{P(i+1)}\right]$$

$$\text{and } \phi_i(\beta) = -\log\left[e^{-\beta z_s(i)} - e^{-\beta z_s(i+1)}\right]$$

a linear relationship similar to (8) is obtained which is as follows

$$y_i + \phi_i'(1) - \phi_i(1) = \alpha + (\beta-1)^2\,\frac{C}{2} + \beta\phi_i'(1) \ldots(9)$$

When fertility has been constant, the y values obtained from mean parities and cumulated fertility rates will define the same straight line. Plotting the two sets of points on the same graph can indicate whether the assumption of constant fertility is a reasonable one. If fertility level has been changing steadily, the line suggested by the 'P' points will be different from that suggested by the 'F' points. In case of declining fertility 'P' line has lower shape and lower intercept than 'F' line. In case of rising fertility, 'P' line has higher slope and higher intercept than 'F' line. The plotting of 'P' points and 'F' points would also help to detect the types of errors present in the data. If the 'P' points curve upwards and if the fertility has been constant then the indication is that there is omission of children ever born by older women. If the 'F' points curve downward at older ages and the fertility has been constant, then there is exaggeration of number of current births to older women. In case of age exaggeration, 'P' and 'F' points both curve downward at older ages. But, in general, if the 'P' and 'F' lines do not converge at the younger ages, errors must be present in one or both sets of data even at younger ages.

1.10 Thus plotting of 'P' and 'F' points would help to indicate whether the fertility has been constant or not. In case of constant fertility it would be possible to estimate the F(x) values from the P(i) values. For this purpose, the parameters α, β and T could be estimated from the P(i) values by equation (7). These values of α, β and T could then be substituted in equation (6) to estimate the values of F(x). The additional advantage of plotting the 'P' points is that it would indicate the points which are on a straight line so that the corresponding parities could be used for estimating the parameters of the model.

1.11 The values of the parameters α, β and T have been estimated as described by Kabir and Howaldar (1981). The value of β has been first estimated by a process of iteration from the relationship

$$\frac{\log P(l)-\log P(k)}{\log P(k)-\log P(j)} = \frac{e^{-\beta z_s(k)} - e^{-\beta z_s(l)}}{e^{-\beta z_s(j)} - e^{-\beta z_s(k)}} \quad \ldots(10)$$

The value of α is obtained using the relationship

$$\alpha = -\log\left[\frac{\log P(l) - \log P(k)}{e^{-\beta z_s(k)} - e^{-\beta z_s(l)}}\right] \ldots\ldots (11)$$

Finally, the value of T is found from the equation

$$T = \exp\left[\log P(l) + e^{-\{\alpha + \beta z_s(l)\}}\right] \ldots(12)$$

In the above equation: P(j), P(k), P(l) and the corresponding $Z_s(j)$, $Z_s(k)$ and $Z_s(l)$ refer to three different age-groups for which the 'P' points are on a straight line.

(b) Mortality

(i) *Brass technique for estimating infant and child mortality.*

1.12 A technique has been developed by Brass (1968) which enables comparison of proportions dead of children ever born reported by women in standard quinquennial age groups past

15 years into probabilities of dying before attaining certain exact age x. If D(i) denotes the proportion dead of children ever born reported by women in the age group i with i = 1, 2, ...7 corresponding to age groups 15-19, 20-24. ... 45-49 years respectively and if q(x) denotes the probability of dying before attaining age x; then, D(1), D(2) ... D(7) have been found to closely approximate q(1), q(2), q(3), q(5), q(10), q(15) and q(20) respectively. The assumptions implied are (i) age specific fertility schedule and age specific mortality schedule have remained almost constant in the recent past, (ii) there is no association between age of mother and infant mortality, (iii) omission rates of dead children are almost of same magnitude as those of the surviving children, and (iv) age pattern of mortality (at least for infants and children) approximately conform to the standard life table selected. The approximate equalities between the D and q values have been found to be affected more strongly by variations in the age pattern of fertility than by variations in the age pattern of mortality. More specifically, the goodness of fit has been found to depend on the starting age of the fertility schedule. Based on the above considerations, a set of multipliers has been developed which enables conversion of D(i) values into q(x) by using the relationship $q(x) = K(i)\ D(i)$, where K(i) is the multiplier determined on the basis of a parameter indicating the starting age of fertility schedule. Generally P(1)/P(2) is used as the parameter for selecting the values of K(i), where P(i) is the average number of children ever born to women in the i th age group.

1.13 The multipliers have been determined on the basis of a polynomial used to generate the fertility schedule and some standard mortality pattern. The fertility polynomial is of the form

$$f(x) = K(x-a)\ (S + 33 - a)^2$$

with $S \leq a \leq S + 33$, where S is the earliest age of child bearing assumed to be 14.5. K is a scale factor.

1.14 For selecting the appropriate multipliers, three indices have been suggested. These are P(1)/P(2) or P(2)/P(3) with P(i) denoting the average parity for the i th age group, the mean age of fertility schedule and the median age of the fertility schedule. The variation in the slope of the fertility curve at the beginning of the reproductive period is considered more important (Brass 1975) than the mean age of the fertility schedule which is influenced by the age pattern of fertility over the whole reproductive span. The P(1)/P(2) or P(2)/P(3) ratio gives an idea as to how the fertility changes with age during the early age of the reproductive span and is therefore appropriate for determining the multipliers for converting the proportions dead of children ever born to women in the younger reproductive ages. Usually, the data on proportion dead of children ever born to women aged 15-19 is affected by random fluctuations due to small number of births involved. On the other hand, the data on proportion dead of children ever born to older women may be affected by "recall lapse" as an element of time lag is involved between the occurrence of events and their reporting. Comparatively, such data in respect of women in the early reproductive age groups except the age group 15-19 years are likely to be more reliable as these are not likely to be affected by "memory lapse", as the events are more recent and the parities are small. Therefore, the estimates of corresponding q(x) values especially q(2) and q(3) may be considered more reliable. The infant and child mortality rates are obtained from the mortality level as indicated by q(2) value corresponding to the West Model Life Table.

(*ii*) *Trussel's method for estimating infant and child mortality*

1.15 Trussel (1975) developed a method to generate a new set of multipliers, K(i) for converting D(i) into q(x) by using the Brass relationship $q(x) = K(i)\ D(i)$. For this purpose, a set of model fertility schedules developed by Coale and Trussel (1974) and mortality schedules from all the four families of the Model Life Tables developed by Coale and Demney (1966) were used. A regression approach to estimate the new set of multipliers was adopted. It was observed that several life table survival rates could be computed with great accuracy using only P(1)/P(2), P(2)/P(3) and D(i) values. The K(i) values have been estimated from the relationship

$$K(i) = a(i) + b(i)\ P(1)/P(2) + c(i)\ P(2)/P(3) \ldots\ldots (13)$$

where P(1), P(2) and P(3) are reported average parities for age groups 15-19, 20-24 and 25-29 years respectively and a(i), b(i) and c(i) are the tabulated values of the regression co-efficients corresponding to West Model Life Tables.

1.16 Procedure for estimation of q(x) values is based on the assumption of constant mortality. However, in actual situations the mortality may not be constant. In such a situation, it could be useful to know the time reference period for each of the estimated q(x) values. The time reference period, t(i), is calculated in terms of the number of years prior to the survey using the relationship

$$t(i) = a(i) + b(i)\ P(1)/P(2) + c(i)\ P(2)/P(3) \ldots\ldots (14)$$

where a(i), b(i) and c(i) are another set of tabulated values of regression coefficients corresponding to West Model Life Tables.

Chapter 2

ESTIMATES OF FERTILITY

The fertility indicators for which estimates have been presented and discussed here include crude birth rate, general fertility rate and total fertility rate representing the fertility level and age specific fertility rates depicting the fertility pattern. In the P/F method, the estimates of age specific fertility rates have been obtained first by adjusting the level of observed age specific fertility rates with the help of information on average parities. Thereafter, the corresponding crude birth rates, general fertility rates and total fertility rates, have been obtained in the usual manner. In the method based on the application of relational Gompertz model, the total fertility rate alongwith the two other parameters of the model has been estimated first from the information on average parities. The age specific fertility rates have been estimated by using the estimated values of the parameters and the standard fertility schedules. The crude birth rates and general fertility rates have been obtained from the estimated age specific fertility rates in the usual manner. The results are discussed in the subsequent paras.

Broad findings

2.1 The estimated crude birth rates, general fertility rates and total fertility rates by P/F method and relational Gompertz model are presented in table 1 alongwith corresponding SRS estimates. At all-India level, the estimated crude birth rate for 1978 by P/F method is found to be 34.1 as compared to SRS estimate of 33.3. The general fertility rate is 143.1 by P/F method and 139.5 from SRS. The corresponding estimates of total fertility rates are 4.6 and 4.5 respectively. Thus, the estimates by P/F method are close to SRS estimates. The estimates by relational Gompertz model at all-India level are found to be 35.8 for crude birth rate, 150.2 for general fertility rate and 4.9 for total fertility rate. These are higher than the corresponding SRS estimates as well as the estimates obtained by P/F method. Both the P/F method and the relational Gompertz model are based on the assumption that there is no appreciable change in fertility. If there is appreciable reduction in fertility, then the reported parities would be higher than those expected on the basis of current fertility schedule. The difference between the reported and expected parities may be small in respect of age group 20-24 years but would be progressively higher for subsequent age-groups. In case of P/F method, the parity value for age-group 20-24 years has generally been used, whereas in case of relational Gompertz model, the parity values for higher age groups 20-34 years have been used. Thus, in case of appreciable reduction in fertility, the estimates by relational Gompertz model are expected to be higher than those by P/F method. The P/F method, in general is likely to depict the current level of fertility. From table 1, it is observed that the estimates of crude birth rate by relational Gompertz model are fairly comparable with corresponding estimates by P/F method in respect of Andhra Pradesh, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Madhya Pradesh, Orissa, Punjab, Rajasthan and Uttar Pradesh. However, for states like Assam, Kerala and Maharashtra the differences are found to be considerable which may be due to perceptible decline in fertility. In the states of Andhra Pradesh, Assam, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra and Uttar Pradesh, the estimates of birth rate obtained by P/F method are within 5 per cent of the corresponding SRS estimates. In the states of Haryana, Jammu & Kashmir, Karnataka, Orissa, Rajasthan and Tamil Nadu, there is indication that the SRS estimates are under reported. However, at the national level, the birth rate obtained by P/F method is 2.4 per cent of the SRS estimate. Discussions in greater details in respect of each of these states follow later.

TABLE 1

Estimated fertility indicators for India and major states, 1978

India/States	P/F method	Relationl Gompertz model	SRS
1	2	3	4
	(a) Crude Birth Rate		
India	34·1	35·8	33·3
Andhra Pradesh	34·4	33·7	33·6
Assam	32·4	39·9	30·8
Gujarat	36·0	36·5	35·8
Haryana	36·9	38·0	33·5
Himachal Pradesh	28·2	31·6	27·3
Jammu & Kashmir	35·5	36·2	31·8
Karnataka	34·3	34·6	29·2
Kerala	26·3	36·9	25·2
Madhya Pradesh	38·7	38·9	37·2
Maharashtra	27·5	32·8	26·9

TABLE 1—*Concld.*

1	2	3	4
Orissa . . .	36·1	36·0	32·9
Punjab . . .	31·5	31·7	29·4
Rajasthan . . .	39·6	39·1	35·5
Tamil Nadu . .	31·9	33·9	28·8
Uttar Pradesh	42·5	42·8	40·4
(b) General Fertility Rate			
India	143·1	150·2	139·5
Andhra Pradesh	140·9	137·5	137·5
Assam	133·6	164·2	127·0
Gujarat	150·9	152·8	150·3
Haryana	167·9	173·0	152·3
Himachal Pradesh	117·4	131·6	113·7
Jammu & Kashmir	149·2	151·7	133·8
Karnataka	140·2	141·1	119·1
Kerala	99·3	139·3	95·2
Madhya Pradesh	168·0	169·3	161·7
Maharashtra	114·3	136·6	112·0
Orissa	147·1	146·8	134·5
Punjab	133·2	134·1	124·7
Rajasthan	173·6	172·0	155·8
Tamil Nadu	124·6	132·1	112·2
Uttar Pradesh	187·3	188·6	178·0
(c) Total Fertility Rate			
India	4·6	4·9	4·5
Andhra Pradesh	4·5	4·5	4·4
Assam	4·1	5·5	4·0
Gujarat	4·9	5·0	4·8
Haryana	5·2	5·5	4·7
Himachal Pradesh	3·6	4·2	3·5
Jammu & Kashmir	5·0	5·1	4·5
Karnataka	4·5	4·5	3·8
Kerala	3·0	4·7	2·9
Madhya Pradesh	5·4	5·6	5·3
Maharashtra	3·6	4·5	3·5
Orissa	4·9	4·9	4·5
Punjab	4·3	4·3	4·0
Rajasthan	5·7	5·7	5·1
Tamil Nadu	3·9	4·2	3·5
Uttar Pradesh	6·3	6·4	6·0

2.2 Table 2 shows classification of states based on percentage difference between estimated crude birth rates by P/F method/relational Gompertz model and corresponding SRS estimates. It is observed that the estimates by P/F method in Andhra Pradesh, Gujarat and Maharashtra are within 3 per cent of the corresponding SRS estimates. For the states of Assam, Himachal Pradesh, Kerala, Madhya Pradesh and Uttar Pradesh, the estimates are in the range of 3 to 6 per cent of the corresponding SRS estimates. There are 4 states, viz. Jammu & Kashmir, Karnataka, Rajasthan and Tamil Nadu for which the estimates by P/F method are higher by a margin of 10 per cent or more than the corresponding SRS estimates. In case of relational Gompertz model, the estimates are within 6 per cent of the corresponding SRS rates for Andhra Pradesh, Gujarat, Madhya Pradesh and Uttar Pradesh. For Orissa and Punjab, the differences between estimates by relational Gompertz model and SRS estimates are in the range of 6 to 10 per cent. For the remaining states, the differences are 10 per cent or more. It has already been mentioned that the estimates by relational Gompertz model are likely to be on the higher side in case there is appreciable reduction in fertility.

TABLE 2

Classification of states based on percentage difference between the estimated crude birth rates by P/F method/relational Gompertz model and SRS rates

Percentage difference	P/F method	Relational Gompertz model
Below 3	India, Andhra Pradesh, Gujarat, Maharashtra	Andhra Pradesh, Gujarat
3 to 6	Assam, Himachal Pradesh, Kerala, Madhya Pradesh, Uttar Pradesh.	Madhya Pradesh, Uttar Pradesh
6 to 10	Orissa, Haryana, Punjab	India, Orissa, Punjab.
10 or more	Jammu & Kashmir, Karnataka, Rajasthan, Tamil Nadu	Assam, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu.

Detailed Analysis

(I) INDIA

2.3 As mentioned earlier, in the case of fertility schedules of standard relational Gompertz pattern, the 'F' points corresponding to $y_x+\phi'_x(1)-\phi_x(1)$ and $\phi'_x(1)$ when plotted on a graph would be on a straight line. Also in the case of average parities based on the fertility schedules of standard relational Gompertz pattern, the 'P' points corresponding to $y_i+\phi'_i(1)-\phi_i(1)$ and $\phi'_i(1)$ when plotted on a graph would fall on a straight line. When there is no appreciable change in fertility, the 'F' points and the 'P' points would define the same straight line. The values of P and F points are shown in table 3.

TABLE 3

Values of P and F points for India

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19	—1·9873	—1·7438	—1·7249	—1·4501
20—24 .	—1·2607	—1·0157	—0·8605	—0·7430
25—29 .	—0·4270	—0·3355	—0·0065	—0·0382
30—34 .	0·4412	0·4391	0·9730	0·8356
35—39 .	2·0181	1·5117	2·3825	2·1649
40—44 .	2·8610	3·2105	3·7480	4·4564

2.4 Chart 1 shows the 'F' and 'P' points plotted for India. Except for the older age groups, the 'F' and 'P' points appear to be approximately on the same straight line. The points in respect of extreme old age groups are out of line which may be due to age misreporting at older ages.

CHART-I

PLOT OF P & F POINTS
INDIA

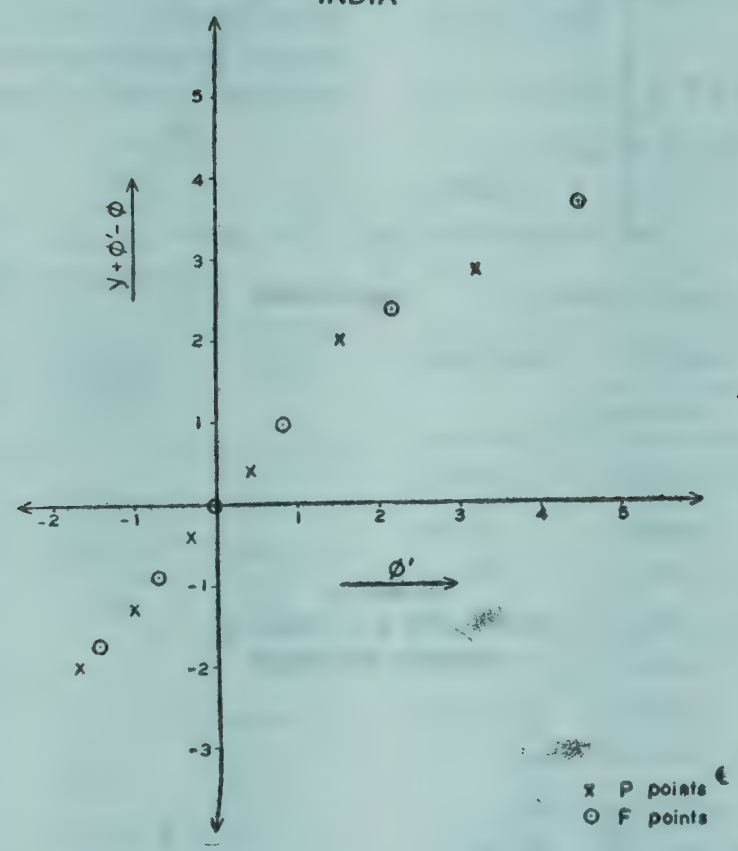


CHART - 2

FERTILITY PATTERN BY AGE
INDIA

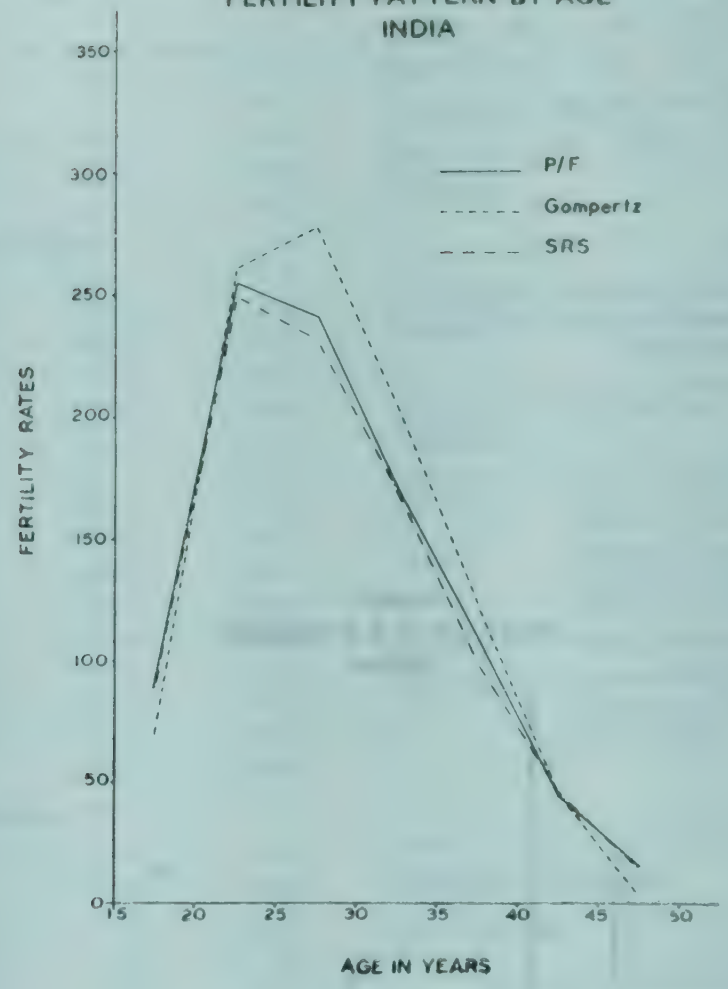
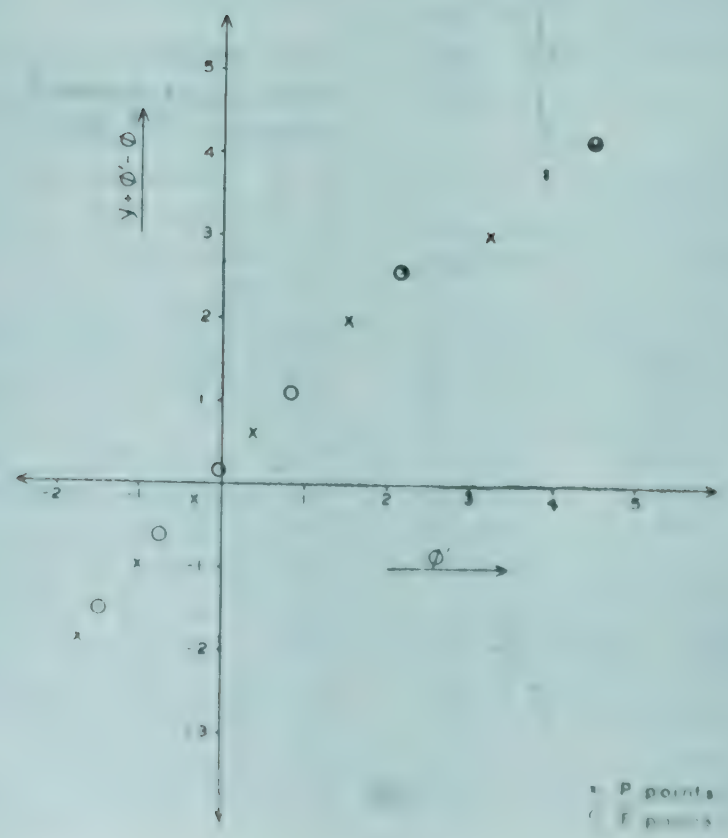


CHART- 3

PLOT OF P & F POINTS
ANDHRA PRADESH



2.5 The estimated fertility indicators obtained by P/F method and relational Gompertz model are shown in table 4. The levels of fertility as indicated by the estimates of crude birth rate, general fertility rate or total fertility rate obtained by the two methods are fairly comparable, although estimates by relational Gompertz model are slightly higher. The crude birth rate is found to be 34.1 by P/F method and 35.6 by relational Gompertz model. The general fertility rate and total fertility rate are, respectively, 143.1 and 4.6 by P/F method and 149.2 and 4.9 by relational Gompertz model. As regards the age pattern of fertility, it is observed that the age specific fertility rates estimated by the two methods indicate slightly different patterns. In the case of relational Gompertz model, the peak age group is found to be 25-29 years but in case of P/F method, the peak age group is 20-24 years. Also the fertility rates in various age groups are found to be higher in the former case than in the latter case except in respect of the two extreme age groups. Chart 2 indicates the fertility pattern by age.

TABLE 4

Estimated fertility indicators for India, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate	34·1	35·6	33·3
General fertility rate	143·1	149·2	139·5
Total fertility rate	4·6	4·9	4·5
Age specific fertility rates			
15—19 years	90·8	68·5	89·1
20—24 years	254·4	260·7	249·1
25—29 years	241·0	276·7	231·5
30—34 years	171·6	204·9	169·9
35—39 years	109·1	121·7	98·9
40—44 years	44·4	44·4	45·2
45—49 years	16·3	4·2	15·9

2.6 The level and the pattern of fertility as revealed by the P/F method are almost the same as those obtained from SRS. The crude birth rate, general fertility rate and total fertility rate from SRS are found to be 33.3, 139,5 and 4.5 respectively which almost agree with the corresponding estimates by P/F method. The fertility rates in various age groups are also almost the same. However, the estimates by relational Gompertz model are higher than the SRS estimates. As regards the age pattern of fertility, the Gompertz model is known to have poorer fit at the tails. Hence the fertility rates for the extreme age groups on either side are found to be very much lower than the SRS estimates or those obtained by P/F method. In the case of remaining age groups the fertility rates as revealed by Gompertz model are uniformly higher than those obtained by P/F method or SRS. As indicated earlier, the relational Gompertz model takes into consideration higher age groups while the P/F method considers only the younger age-group (20-24 years). In the case of a declining trend in fertility, the estimates obtained by P/F method are likely to be more representative than the other method, since the Gompertz method gives higher estimates of fertility on account of the fact that reduction in fertility is generally observed among women of higher ages.

(II) ANDHRA PRADESH

2.7 Table 5 presents the values of P and F points.

TABLE 5

Values of P and F points for Andhra Pradesh

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19	—1·8714	—1·7438	—1·5414	—1·4501
20—24	—0·9967	—1·0157	—0·6516	—0·7430
25—29	—0·1788	—0·3355	—0·1693	—0·0382
30—34	0·6141	0·4391	1·1173	0·8356
35—39	1·9675	1·5117	2·5688	2·1649
40—44	3·0453	3·2105	4·1602	4·4564

Chart 3 shows 'P' and 'F' points plotted on a graph. The two sets of points seem to define the same straight line. The two points on the extreme right, one 'P' point and one 'F' point are well below this line which is perhaps an indication of age misreporting at older ages.

2.8 The estimated fertility indicators by P/F method and the relational Gompertz model are presented in Table 6 alongwith the corresponding SRS estimates. The estimates by P/F method are consistent with the SRS estimates with regard to level as well as pattern of fertility. The estimates by relational Gompertz model are also quite consistent with the SRS estimates. The crude birth rate is found to be 34.4 by P/F method, 33.7 by relational Gompertz model and 33.6 as per SRS estimates. The corresponding estimates of

general fertility rate are 140.9, 137.5 and 137.5 respectively. The estimates of total fertility rate in the same order are 4.5, 4.5 and 4.4. The estimated age specific fertility rates as obtained by P/F method and from SRS indicate the same pattern. The estimates by relational Gompertz model also broadly indicate similar pattern. As the Gompertz model is known to have poorer fit at the tails than at the central age groups, the estimates for the extreme age groups on either side are found to be much lower in this case. Chart 4 depicts the fertility pattern by age group.

TABLE 6

Estimated fertility indicators for Andhra Pradesh, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . .	34·4	33·7	33·6
General fertility rate .	140·9	137·5	137·5
Total fertility rate .	4·5	4·5	4·4
Age specific fertility rates			
15—19 years . .	133·6	106·5	136·2
20—24 years . .	263·9	248·0	262·8
25—29 years . .	213·3	228·9	206·3
30—34 years . .	147·7	168·3	136·8
35—39 years . .	93·5	105·6	83·7
40—44 years . .	39·2	43·2	33·5
45—49 years . .	10·1	5·0	10·1

(III) ASSAM

2.9 The values of P and F points are shown in table 7.

TABLE 7

Values of P and F points for Assam

Age group	P points		F Points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—1·9569	—1·7438	—1·7287	—1·4501
20—24 .	—1·3387	—1·0157	—0·7794	—0·7430
25—29 .	—0·5637	—0·3355	—0·0031	—0·0382
30—34 .	0·2656	0·4391	1·0717	0·8356
35—39 .	1·6648	1·5117	2·8393	2·1649
40—44 .	3·3173	3·2105	5·4753	4·4564

The 'P' and 'F' points as plotted in chart 5 indicate that the straight lines which can be drawn though these two sets of points have different slopes and intercepts. The 'P' line seems to have lower slope and smaller intercept than the 'F' line which is an indication of declining fertility.

2.10 When the fertility has been declining the estimated level of fertility by relational Gompertz model is likely to be on the higher side and would not be representative of the current fertility level. Accordingly, it is observed from table 8 that the estimates of crude birth rate, general fertility rate and total fertility rate by relational Gompertz model are considerably higher than the corresponding estimates by P/F method. The birth rate is found to be 39.9 by relational Gompertz model as compared to 32.4 by P/F method. The general fertility rate and total fertility rate are respectively 164.2 and 5.5 by relational Gompertz model and 133.6 and 4.1 by P/F method. The estimates by P/F method may not be on the higher side, as in this case the level of fertility has been adjusted on the basis of average parity for age group 20-24 years which represents the fertility experience of the recent years. These estimates are found to be relatively higher than the corresponding SRS estimates which are 30.8 for birth rate, 127.0 for general fertility rate and 4.0 for total fertility rate. The age specific rates estimated by P/F method are found to be similar to the SRS estimates for most of the age groups. The estimates by relational Gompertz model are found to be considerably higher except for the initial age group. Chart 6 depicts the fertility rates by age group.

TABLE 8

Estimated fertility indicators for Assam, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . .	32·4	39·9	30·8
General fertility rate .	133·6	164·2	127·0
Total fertility rate .	4·1	5·5	4·0
Age specific fertility rates			
15—19 years . .	91·1	59·8	83·9
20—24 years . .	222·8	250·4	196·3
25—29 years . .	223·8	300·4	227·4
30—34 years . .	180·2	249·0	158·7
35—39 years . .	83·4	165·4	97·8
40—44 years . .	23·6	68·5	30·2
45—49 years . .	2·2	7·9	3·0

(IV) GUJARAT

2.11 The values of P and F points are shown in table 9.

TABLE 9

Values of P and F points for Gujarat

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 .	2·2861	1·7438	—2·0376	1·4501
20—24 .	—1·3823	—1·0157	—0·9647	—0·7430
25—29 .	—0·4575	—0·3355	—0·0065	—0·0382
30—34 .	—0·4698	0·4391	1·0474	0·8356
35—39 .	1·6218	1·5117	2·4879	2·1649
40—44 .	3·1380	3·2105	4·0582	4·4564

CHART-4

FERTILITY PATTERN BY AGE
ANDHRA PRADESH

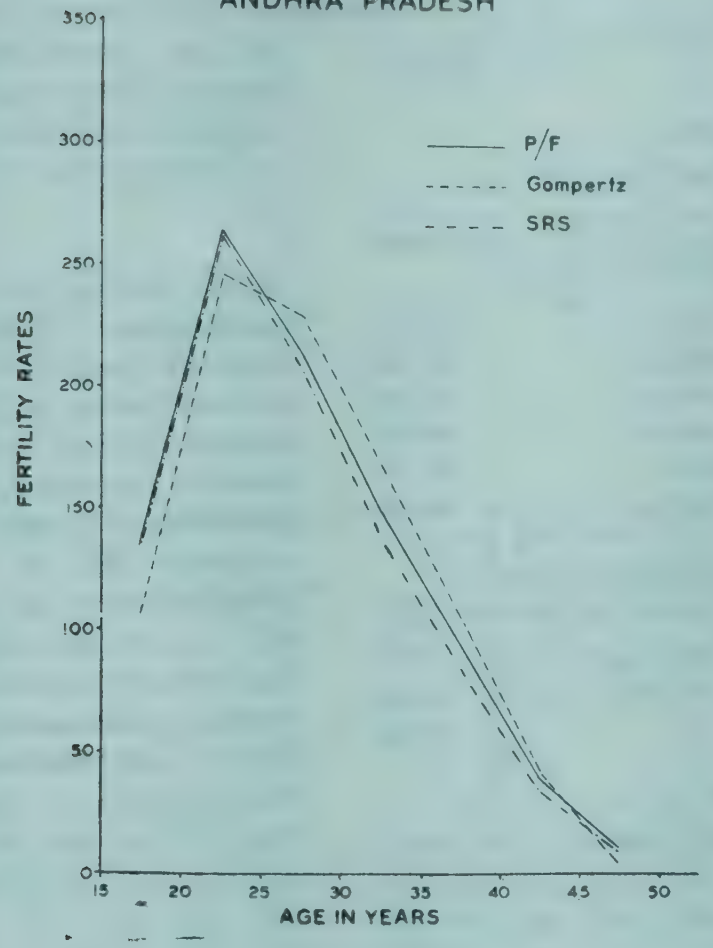


CHART-5

PLOT OF P & F POINTS
ASSAM

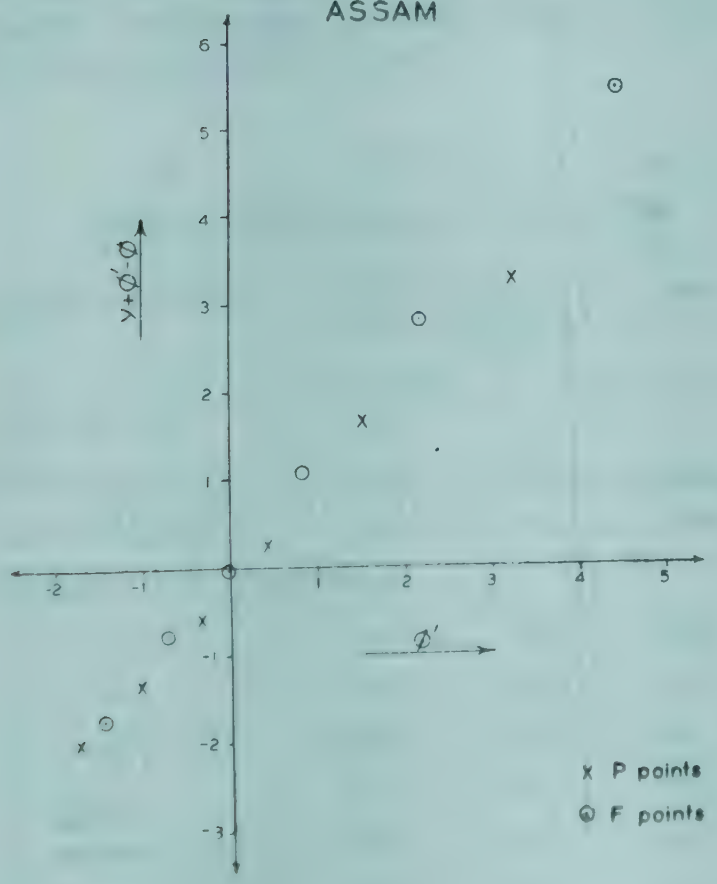


CHART-6

FERTILITY PATTERN BY AGE
ASSAM

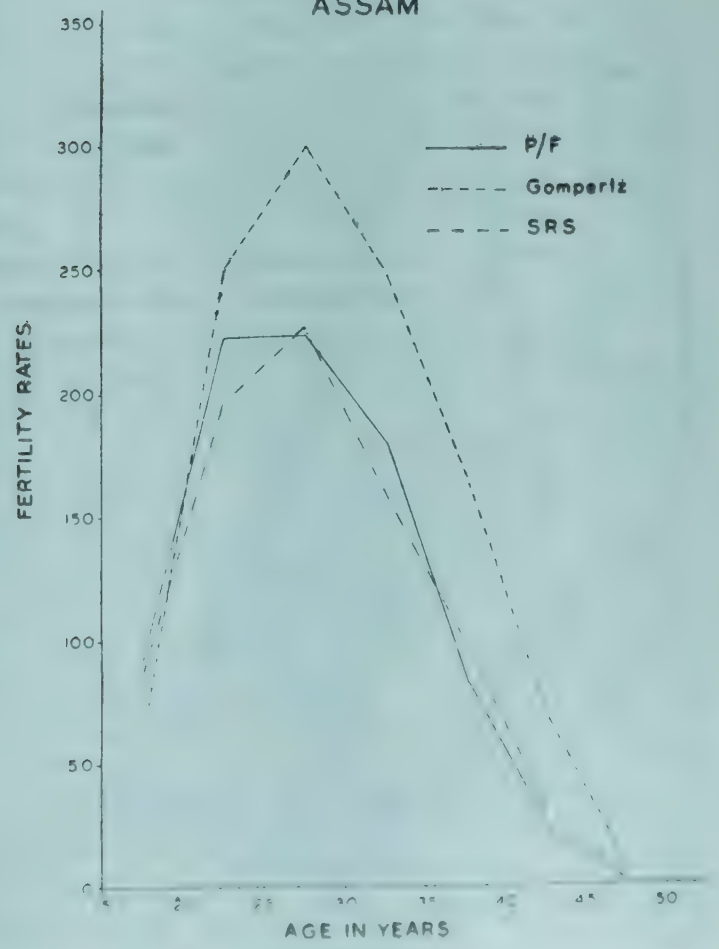


CHART - 7
PLOT OF P & F POINTS
GUJARAT

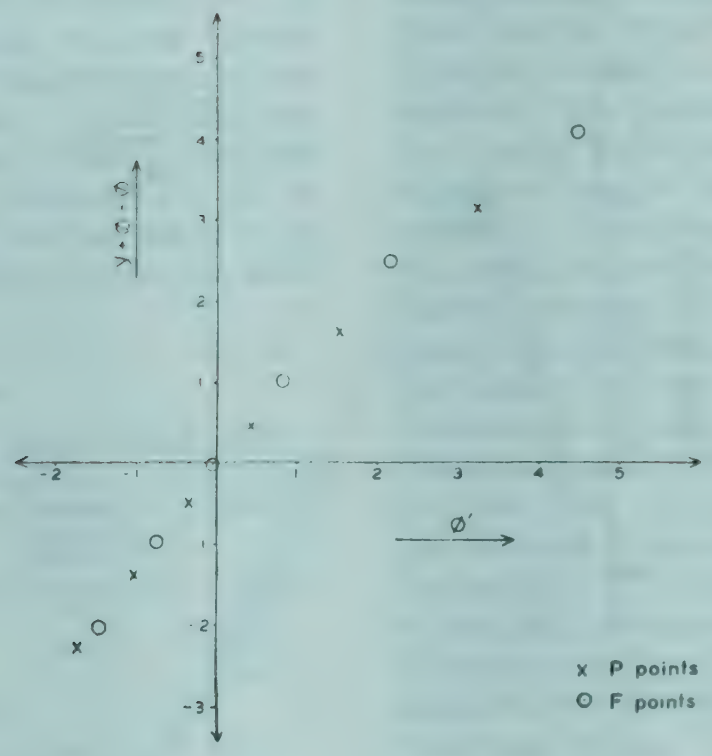


CHART-8
FERTILITY PATTERN BY AGE
GUJARAT

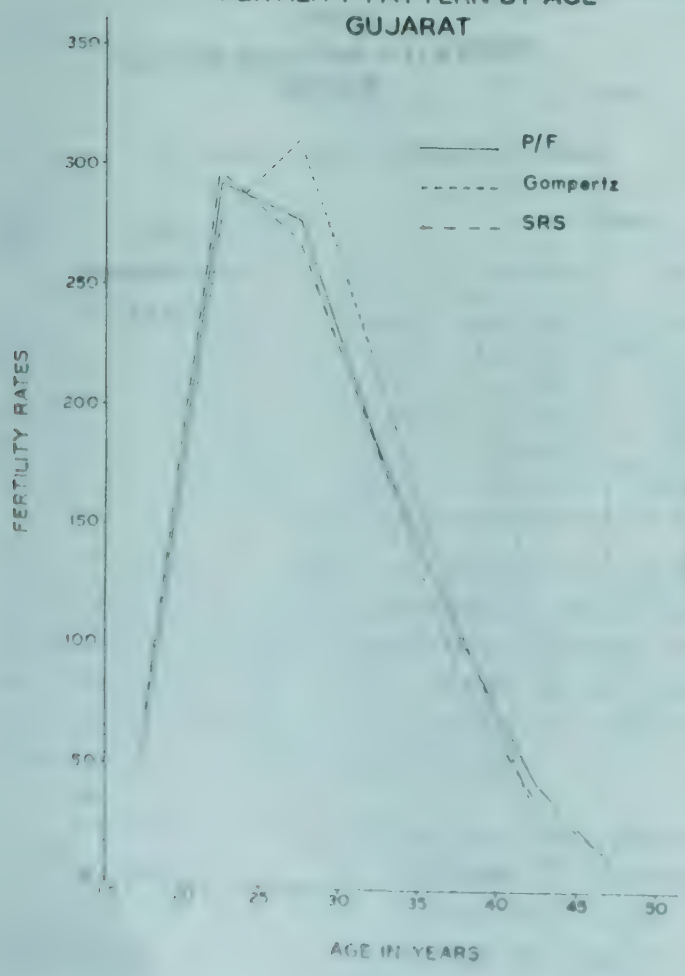


CHART - 9
PLOT OF P & F POINTS
HARYANA

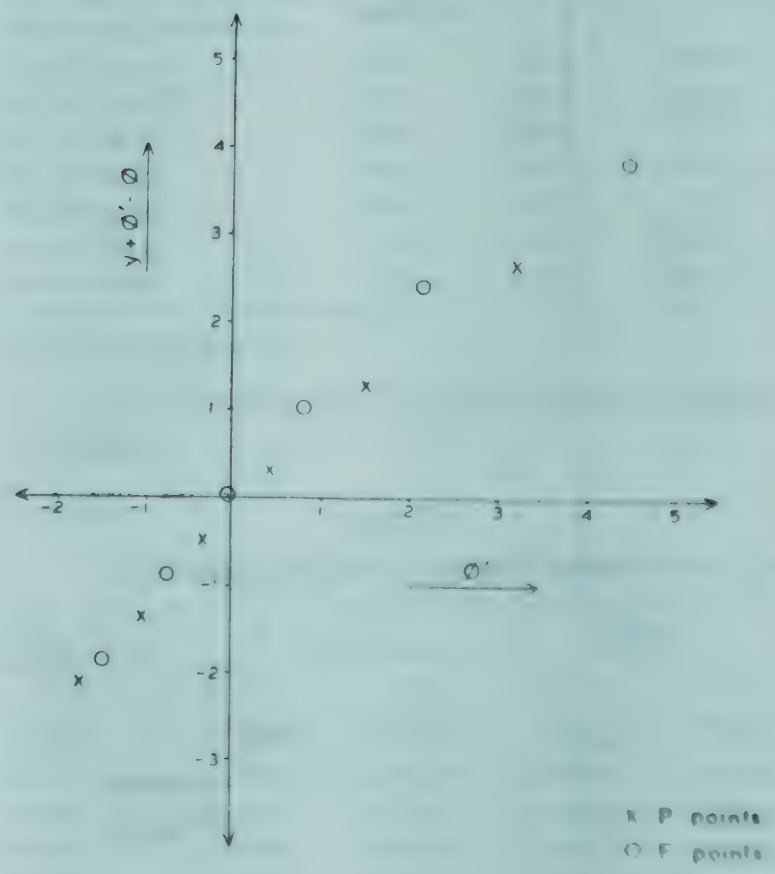


Chart 7 shows the plots of 'P' and 'F' points. The 'P' and 'F' points except the two on the extreme right seem to be approximately on the same straight line. The two points on the extreme right fall well below this line and this may be an indication of the misreporting at older ages.

2.12 Table 10 provides a comparison of the estimates of fertility obtained by P/F method and relational Gompertz model and those obtained from SRS. It is observed that the overall level of fertility as indicated by the three sets of estimates is almost the same. The crude birth rate is found to be 36.0 by P/F method, 36.5 by relational Gompertz model and 35.8 as per SRS estimates. The corresponding estimates of general fertility rate are respectively 150.9, 152.8 and 150.3. The estimates of total fertility rate are 4.9, 5.0 and 4.8 in the same order. With regard to the age pattern of fertility, the age specific rates estimated by P/F method and from SRS are found to indicate almost the same pattern. However, the age specific rates estimated by relational Gompertz model are found to follow a different pattern. In this case, the rates for extreme age groups on either side are lower and the rates for central age groups are higher than those obtained by P/F method as well as those obtained from SRS. Also the peak age group is found to be 25-29 years in case of relational Gompertz model as compared to 20-24 years in case of P/F method and SRS estimates. The age specific fertility rates as obtained from the three sources are presented in Chart 8.

TABLE 10

Estimated fertility indicators for Gujarat, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate	36·0	36·5	35·8
General fertility rate	150·9	152·8	150·3
Total fertility rate	4·9	5·0	4·8
Age specific fertility rates			
15—19 years	58·6	49·5	66·4
20—24 years	293·2	278·6	297·2
25—29 years	276·8	310·3	268·4
30—34 years	181·7	213·2	182·6
35—39 years	107·2	111·1	92·1
40—44 years	45·8	33·4	38·6
45—49 years	10·3	2·3	12·6

(V) HARYANA

2.13 The values of P and F points are shown in table 11.

TABLE 11

Values of P and F points for Haryana

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19	—2.1270	—1.7438	—1.8578	—1.4501
20—24	—1.3863	—1.0157	—0.8846	—0.7430
25—29	—0.4911	—0.3355	0.0064	—0.0382
30—34	0.3022	0.4391	1.0512	0.8356
35—39	1.2760	1.5117	2.4095	2.1649
40—44	2.6631	3.2105	3.8314	4.4564

Chart 9 shows the plots of 'P' and 'F' points. The two sets of points appear to be along a straight line initially and then curve downwards at older ages. There may be age misreporting at older ages.

2.14 In case of P/F method, the correction factor for adjusting the observed age specific fertility rates has generally been taken as the P/F ratio for the age group 20-24 years. However, in the present case, the P/F ratio for the age-group 20-24 years is found to be very much lower than the ratios for successive higher age groups. There is an abrupt increase in the ratio over the age groups 20-24 years to 25-29 years. Therefore, instead of using the ratio for either of the two age groups 20-24 years or 25-29 years as correction factor, weighted average of the ratios for three successive age groups 20-24 years to 30-34 years has been used as a correction factor in this case. In case of relational Gompertz model also, the average parities for these three age groups have been used for estimating the various fertility indicators. The estimates by the two methods are shown in table 12 alongwith the corresponding SRS estimates. The estimated crude birth rate is found to be 36.9 by P/F method, 38.0 by relational Gompertz model and 33.5 from SRS. The corresponding estimated general fertility rates are 167.9, 173.0 and 152.3 respectively. The estimates of total fertility rates in the same order are 5.2, 5.5 and 4.7. The level of fertility as indicated by the SRS is underreported. The age pattern of fertility as per the corresponding estimates of age specific fertility rates is found to be different. Except for the age group 20-24 years, the fertility rates as obtained by P/F method and relational Gompertz model are widely different. Also the peak age group in the former case is found to be 20-24 years as compared to 25-29 years in the latter case. The SRS estimates of age specific fertility rates follow almost the same pattern as the estimates by P/F method

but the estimates in the former case are generally lower than those in the latter case. The age specific fertility rates from the three sources are shown in chart 10.

TABLE 12

Estimated fertility indicators for Haryana, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate	36.9	38.0	33.5
General fertility rate	167.9	173.0	152.3
Total fertility rate	5.2	5.5	4.7
Age specific fertility rates			
15—19 years	85.4	44.7	71.6
20—24 years	302.2	301.0	269.0
25—29 years	277.1	350.3	250.6
30—34 years	190.3	238.4	190.3
35—39 years	113.4	120.2	97.0
40—44 years	53.1	34.3	56.2
45—49 years	16.5	2.2	13.4

(VI) HIMACHAL PRADESH

2.15 The values of P and F points are shown in table 13.

TABLE 13

Values of P and F points for Himachal Pradesh

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19	—2.2435	—1.7438	—1.8681	—1.4501
20—24	—1.3026	—1.0157	—0.6516	—0.7430
25—29	—0.4107	—0.3355	0.3901	—0.0382
30—34	0.4152	0.4391	1.5751	0.8356
35—39	1.7041	1.5117	2.5668	2.1649
40—44	3.8340	3.2105	4.6755	4.4564

Chart 11 shows plots of 'P' and 'F' points. All the 'P' points appear to be on the same straight line. However, all the 'F' points are not on the same straight line. In this case, the points for younger age groups are approximately on the same line but the points on the extreme right corresponding to older age groups are found to be below this line. The 'P' line appears to have a lower slope and smaller intercept than the 'F' line which may be an indication of a declining fertility.

2.16 In case of a declining fertility, the estimates by relational Gompertz model are likely to be on the higher side. Table 14 provides a comparison of the estimates of fertility indicators obtained by relational Gompertz model with those obtained by P/F method and those obtained from SRS. The estimated level of fertility by relational Gompertz model is found to be quite higher than that obtained by P/F method or from SRS. The crude birth rate is found to be 31.6 by relational Gompertz model, 28.2 by P/F method and 27.3 from SRS. The general fertility rate and total fertility rate are respectively 131.6 and 4.2 by relational Gompertz model, 117.4 and 3.6 by P/F method and 113.7 and 3.5 from SRS. The pattern of fertility as indicated by the age specific fertility rates estimated by relational Gompertz model is also found to be different from that indicated by the corresponding estimates obtained by P/F method and from SRS. In the former case the peak age group is found to be 25-29 years as compared to 20-24 years in the latter two cases. Chart 12 presents the fertility pattern by age from the three sources.

TABLE 14

Estimated fertility indicators for Himachal Pradesh, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate	28.2	31.6	27.3
General fertility rate	117.4	131.6	113.7
Total fertility rate	3.6	4.2	3.5
Age specific fertility rates			
15—19 years	80.2	53.0	77.3
20—24 years	271.0	239.2	261.5
25—29 years	181.6	252.4	174.6
30—34 years	98.4	175.3	103.6
35—39 years	49.6	95.0	37.2
40—44 years	31.0	30.5	31.5
45—49 years	4.6	2.4	6.1

2.17 From discussions in para 2.16 it follows that the estimates by P/F method are quite consistent with the SRS estimates with regard to both level as well as pattern of fertility. However, the estimates by relational Gompertz model are not quite consistent with either of the two sets of estimates obtained from SRS or by P/F method. The level of fertility indicated by the estimates obtained by relational Gompertz model is likely to be on the higher side because of an indication of a declining fertility. Corresponding to a decline in the level of fertility, there may be change in the age pattern of fertility. Also the Gompertz model is known to give poorer fit at the tails. As such the pattern of fertility indicated by estimates obtained by relational Gompertz model may be different from that indicated by the estimates from SRS or by P/F method.

CHART-10

FERTILITY PATTERN BY AGE
HARYANA

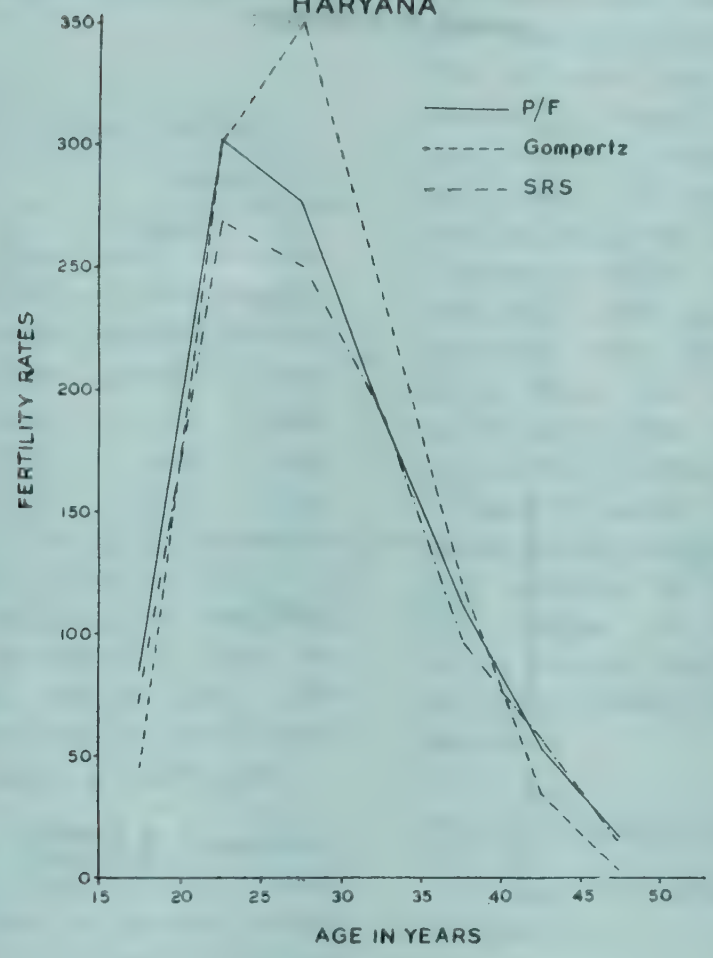


CHART-11

PLOT OF P & F POINTS
HIMACHAL PRADESH

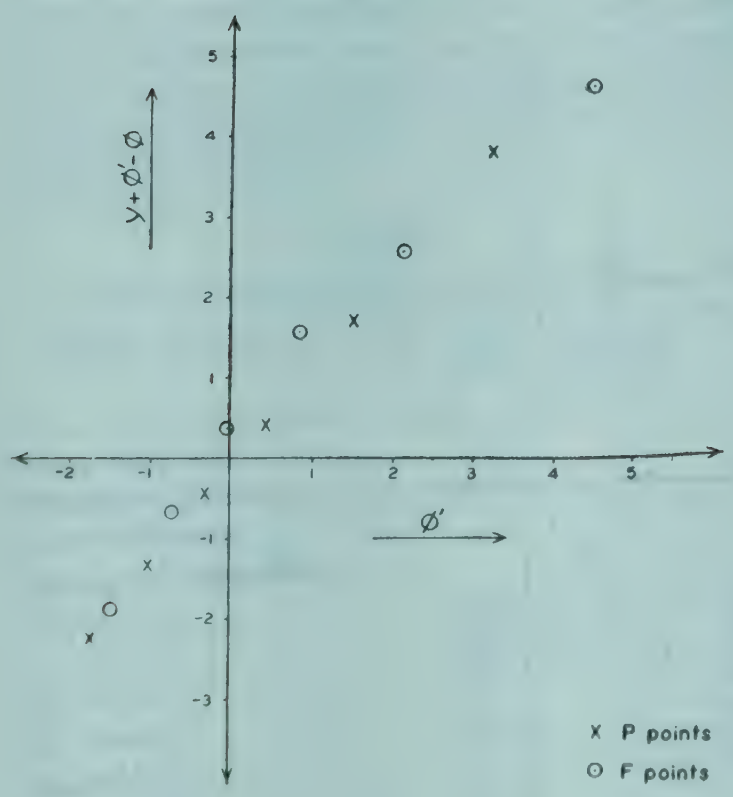


CHART-12

FERTILITY PATTERN BY AGE
HIMACHAL PRADESH

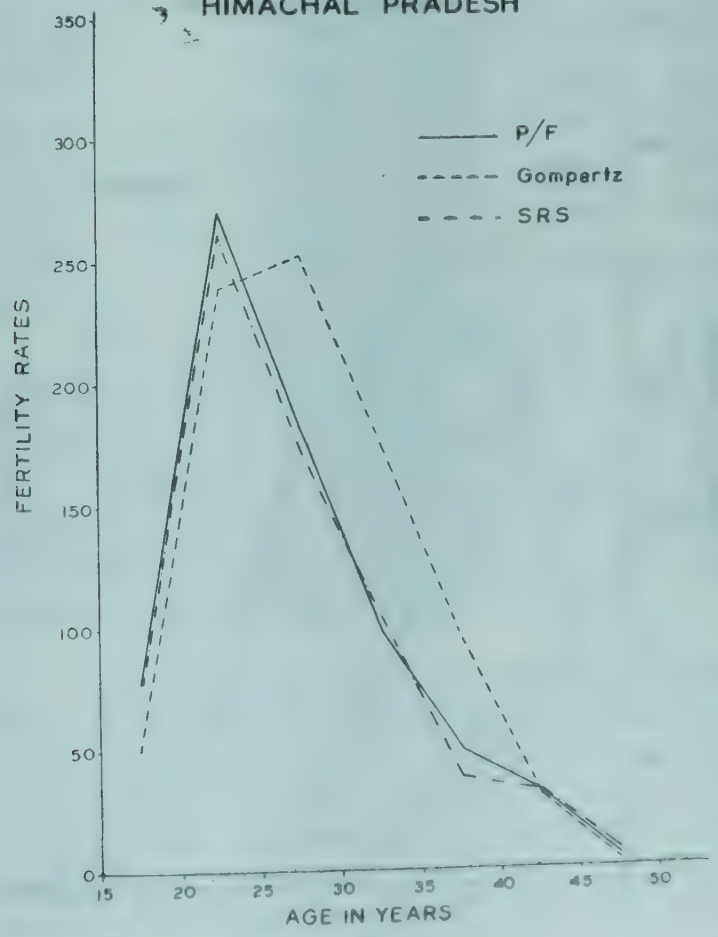


CHART-13
PLOT OF P & F POINTS
JAMMU & KASHMIR

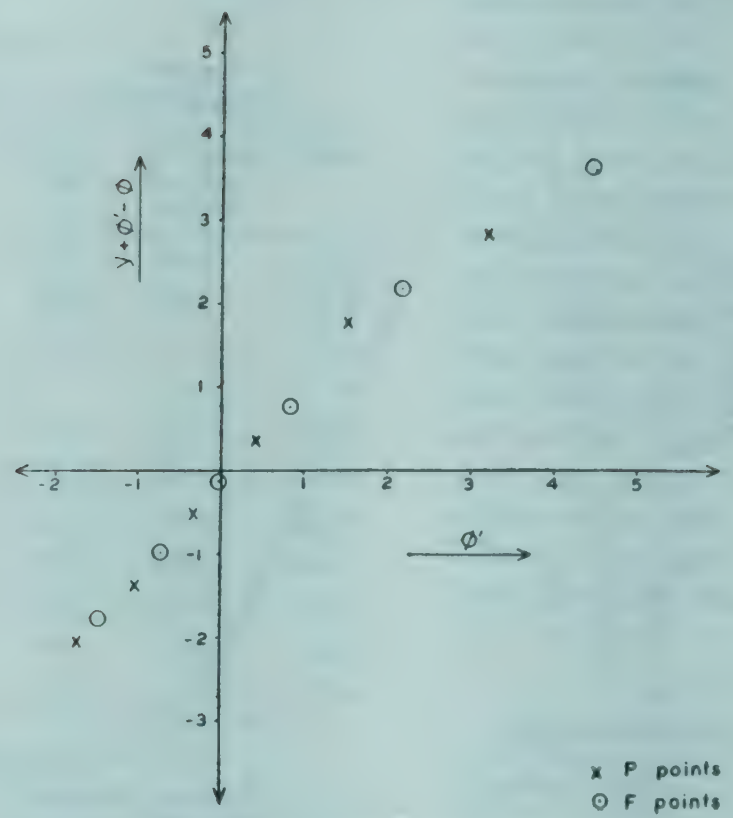


CHART-14
FERTILITY PATTERN BY AGE
JAMMU & KASHMIR

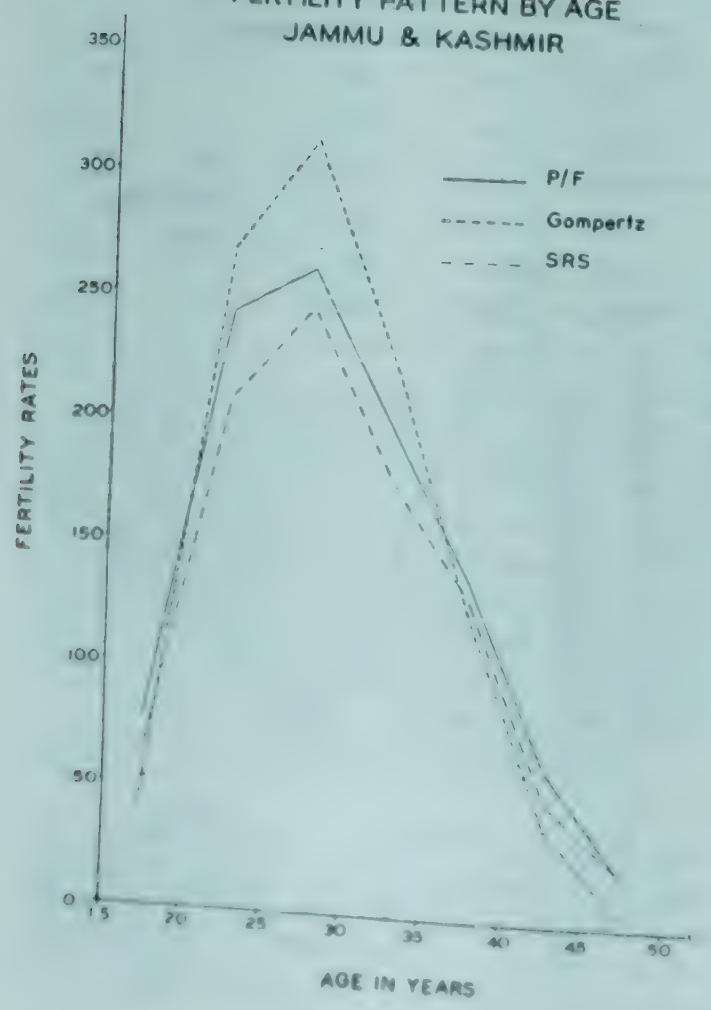
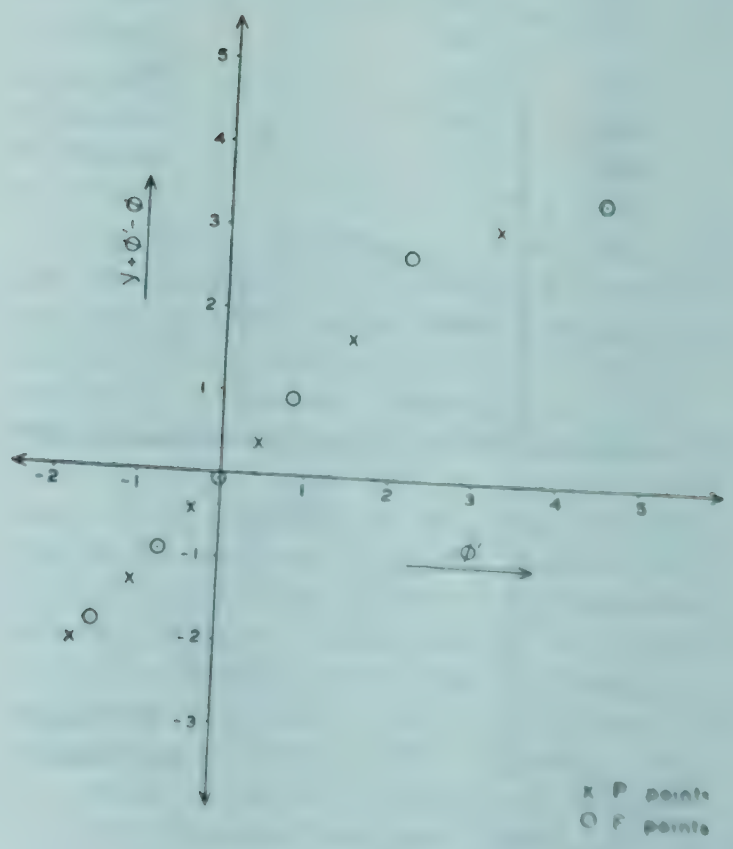


CHART-15
PLOT OF P & F POINTS
KARNATAKA



(VII) JAMMU & KASHMIR

2.18 The values of P and F points are shown in table 15.

TABLE 15

Values of P and F points for Jammu & Kashmir

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—2.0578	—1.7438	—1.7759	—1.4501
20—24 . .	—1.3989	—1.0157	—0.9735	—0.7430
25—29 . .	—0.5062	—0.3355	—0.1439	—0.0382
30—34 . .	0.3807	0.4391	0.7834	0.8356
35—39 . .	1.7709	1.5117	2.1974	2.1649
40—44 . .	2.8031	3.2105	3.6229	4.4564

The 'P' and 'F' points plotted in chart 13 appear to define the same straight line as all the points except the two on the extreme right are approximately on the same straight line. The points on the extreme right are below this line and may be due to age misreporting at older ages.

2.19 So far as level of fertility is concerned, the estimates obtained by P/F method and relational Gompertz model are found to be quite consistent. However, the level as indicated in either of these cases is found to be quite higher than that indicated by SRS estimates. Table 16 shows the estimates of various fertility indicators obtained by different methods. The crude birth rate is found to be 35.5 by P/F method, 36.2 by relational Gompertz model and 31.8 from SRS. The corresponding general fertility rate and total fertility rate are respectively 149.2 and 5.0 by P/F method. 151.7 and 5.1 by relational Gompertz model and 133.8 and 4.5 from SRS. The SRS estimate seems to be under-reported.

TABLE 16

Estimated fertility indicators for Jammu & Kashmir, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . .	35.5	36.2	31.8
General fertility rate . .	149.2	151.7	133.8
Total fertility rate . .	5.0	5.1	4.5
Age specific fertility rates			
15—19 years . . .	77.2	48.5	64.4
20—24 years . . .	243.3	268.9	207.5
25—29 years . . .	261.3	312.2	245.8
30—34 years . . .	200.1	226.3	179.3
35—39 years . . .	138.2	125.0	132.3
40—44 years . . .	62.2	40.4	51.5
45—49 years . . .	20.0	3.1	21.3

2.20 When the age specific fertility rates are considered, it is observed that the estimates in all the three cases broadly indicate similar pattern. The peak age group in all the cases is 25-29 years. The estimated age specific fertility rates by P/F method are found to be higher than the corresponding SRS estimates for all age groups except 45-49 years. As compared to the estimates by P/F method and from SRS, the estimates by relational Gompertz model are found to be lower at the tails, that is, for age below 20 years and age above 34 years. For the central age groups that is 20-34 years, the rates by relational Gompertz model are higher. Apparently, this may be due to relatively poorer fit at the tails in case of a Gompertz model. However, the apparent differences between the estimated age-specific fertility rates obtained by relational Gompertz model and P/F method do not bring about any difference in the overall level of fertility. Chart 14 depicts the age specific fertility rates from different sources.

(VIII) KARNATAKA

2.21 The values of P and F points are shown in table 17.

TABLE 17

Values of P and F Points for Karnataka

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—2.0731	—1.7438	—1.8315	—1.4501
20—24 . .	—1.3379	—1.0157	—0.9288	—0.7430
25—29 . .	—0.4352	—0.3355	—0.0527	—0.0382
30—34 . .	0.3617	0.4391	0.9301	0.8356
35—39 . .	1.6616	1.5117	2.6791	2.1649
40—44 . .	3.0178	3.2105	3.4021	4.4564

Chart 15 shows 'P' points and 'F' points plotted on a graph. Except one 'P' point and one 'F' point on the extreme right, all the other points appear to be approximately on the same line. Thus, the 'P' and 'F' points approximately define the same line in this case. The points on the extreme right lie below this line which may be due to misreporting of age at older ages.

2.22 It may be seen from table 18 that the level of fertility as indicated by the estimates of crude birth rate, general fertility rate or total fertility rate is almost identical in case of P/F method and relational Gompertz model. The estimates are respectively 34.3, 140.2 and 4.5 in case of P/F method and 34.6, 141.1 and 4.5 in

case of relational Gompertz model. The corresponding SRS estimates are respectively 29.2, 119.1 and 3.8 which are relatively lower. The SRS estimates appear to be under-reported.

TABLE 18

Estimated fertility indicators for Karnataka, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . . .	34.3	34.6	29.2
General fertility rate . .	140.2	141.1	119.1
Total fertility rate . .	4.5	4.5	3.8
Age specific fertility rates			
15—19 years . . .	71.8	51.9	65.7
20—24 years . .	245.7	252.5	208.6
25—29 years . . .	241.5	273.2	200.8
30—34 years . . .	171.9	190.6	140.3
35—39 years . . .	109.4	102.7	94.8
40—44 years . . .	44.1	32.6	33.9
45—49 years . . .	13.9	2.5	13.0

2.23 The age specific fertility rates estimated by relational Gompertz model are lower at the tails and higher in respect of the central age groups as compared to the corresponding rates estimated by P/F method and those obtained from SRS. Also the peak age group in the former case is found to be 25-29 years as compared to 20-24 years in the latter two cases. However, the apparent difference between the estimated age specific fertility rates obtained by relational Gompertz model and those obtained by P/F method do not bring about any difference in the overall level of fertility, as indicated by the estimates of crude birth rate, general fertility rate and total fertility rate. The age specific fertility rates from the three sources are presented in chart 16.

(IX) KERALA

2.24 The values of P and F points are shown in table 19.

TABLE 19

Values of P and F points for Kerala

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—2.1429	—1.7438	—1.8980	—1.4501
20—24 . .	—1.4160	—1.0157	—0.8923	—0.7430
25—29 . .	—0.6651	—0.3355	—0.0386	—0.0382
30—34 . .	0.1606	0.4391	1.0864	0.8356
35—39 . .	1.3919	1.5117	2.7110	2.1649
40—44 . .	2.3548	3.2105	4.9015	4.4564

The 'P' and 'F' points are plotted in chart 17. The 'P' line and the 'F' line which correspond to the sets of 'P' and 'F' points respectively appear to have different slopes and intercepts. The 'P' line appears to have a lower slope and smaller intercept than the 'F' line indicating decline in fertility.

2.25 It has been mentioned earlier that in case of declining fertility the estimated level by relational Gompertz model is likely to be on the higher side. From table 20, it is observed that the estimated crude birth rate, general fertility rate and total fertility rate by relational Gompertz model are considerably higher than the corresponding estimates by P/F method. The estimates in the former case are 36.9, 139.3 and 4.7 respectively; whereas those in the latter case are 26.3, 99.3 and 3.0 respectively. The estimates of fertility as derived by P/F method are close to SRS estimates. Corresponding to a change in the fertility level, there may be a change in the fertility pattern also. It is possible that the decline in the fertility may be due to decline in the higher parity births in which case the decline in age specific fertility rates would be more in case of latter reproductive age groups than the early reproductive age groups. In such a situation, the estimated fertility schedules based on the average parity data may not truely represent the current fertility pattern. Table 20 shows that the age specific fertility rates estimated by relational Gompertz model are very much different from those estimated by P/F method. The estimated rate for the age group 15-19 years is lower, in the former case than in the latter case. For the remaining age groups the rates are higher in case of relational Gompertz model than in the case of P/F method. The differences between the two sets of rates are more for the latter reproductive age groups than the early reproductive age groups. It is likely that reduction in fertility has occurred among older women by curtailing higher order births. The age specific fertility rates are shown in chart 18.

TABLE 20

Estimated fertility indicators for Kerala, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . . .	26.3	36.9	25.2
General fertility rate . .	99.3	139.3	95.2
Total fertility rate . .	3.0	4.7	2.9
Age specific fertility rates			
15—19 years . .	49.6	40.4	45.2
20—24 years . . .	188.1	190.1	179.6
25—29 years . . .	170.6	251.2	164.9
30—34 years . . .	112.4	224.8	105.5
35—39 years . . .	65.4	159.9	65.2
40—44 years . . .	22.4	71.5	19.2
45—49 years . . .	3.2	9.0	3.6

CHART-16

FERTILITY PATTERN BY AGE
KARNATAKA

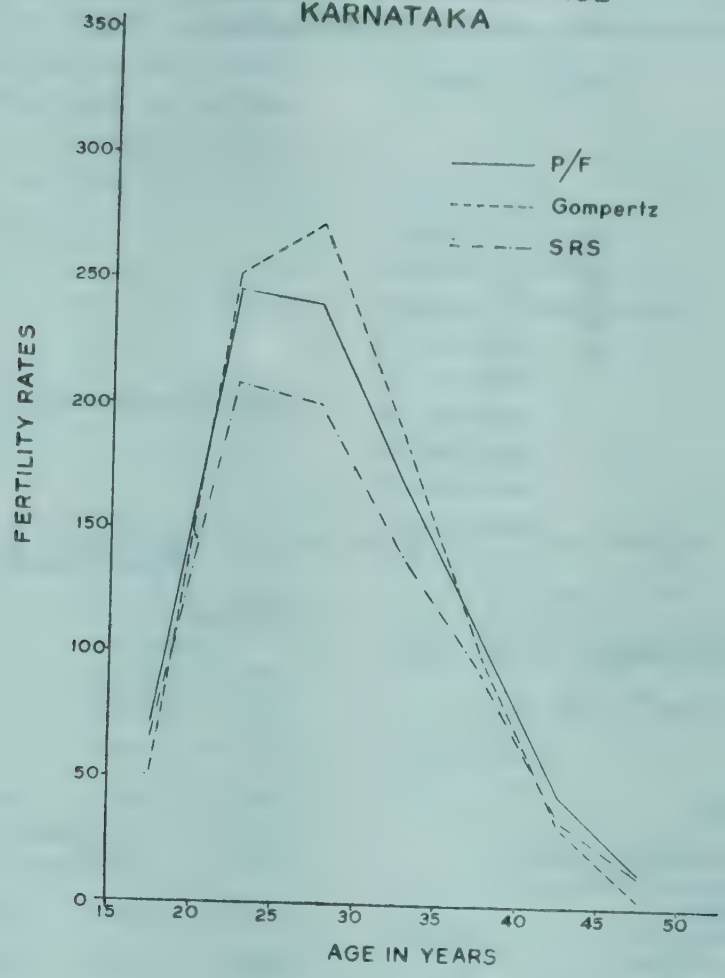


CHART-17

PLOT OF P & F POINTS
KERALA

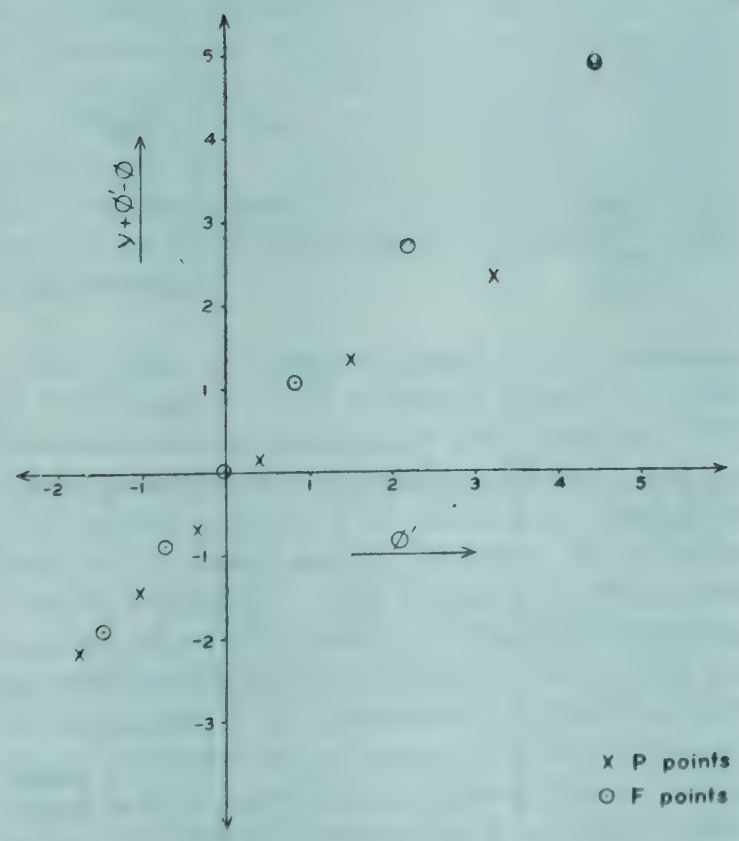


CHART-18

FERTILITY PATTERN BY AGE
KERALA

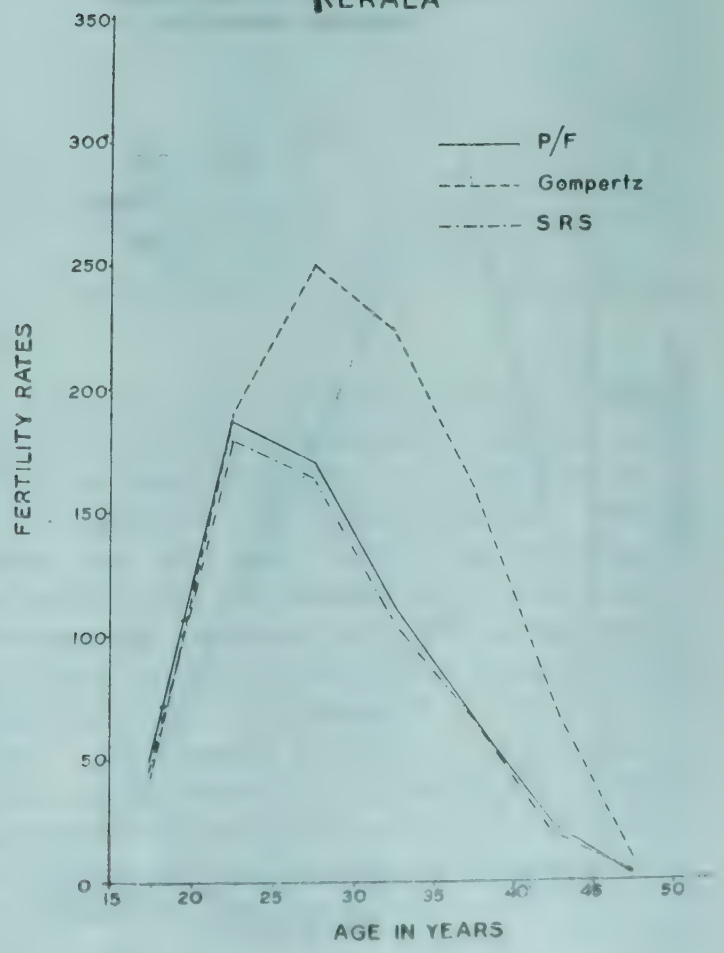


CHART - 19

PLOT OF P & F POINTS
MADHYA PRADESH

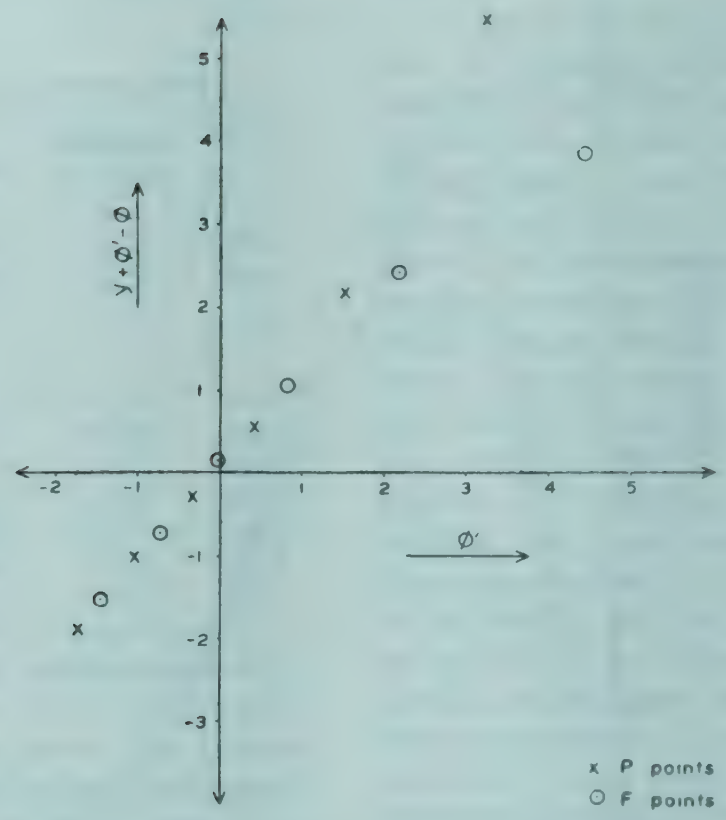


CHART - 20

FERTILITY PATTERN BY AGE
MADHYA PRADESH

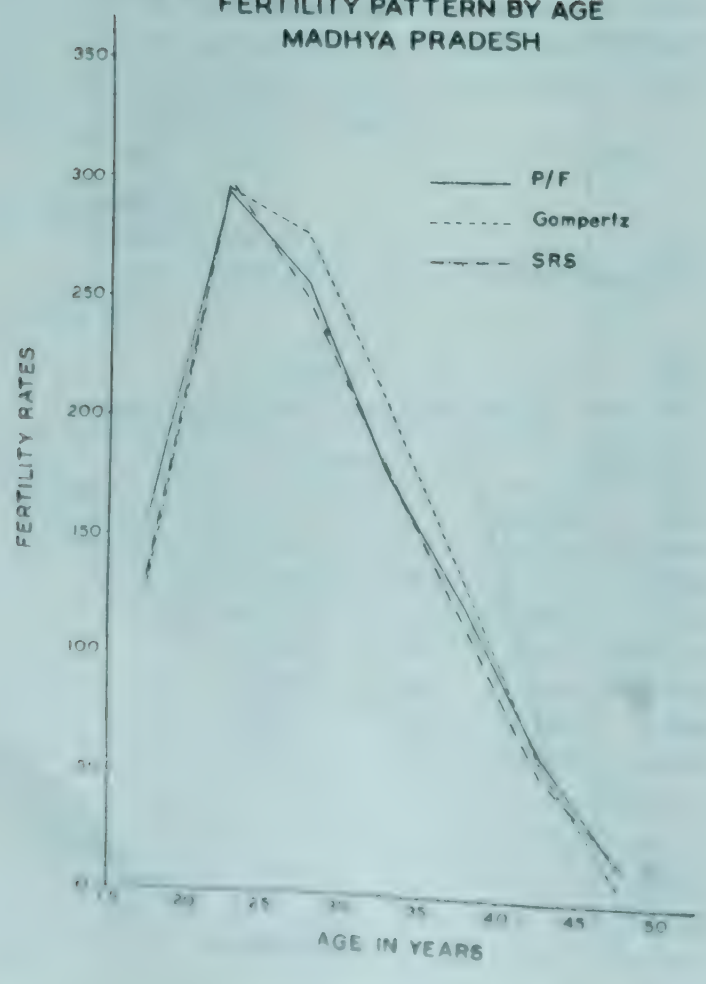
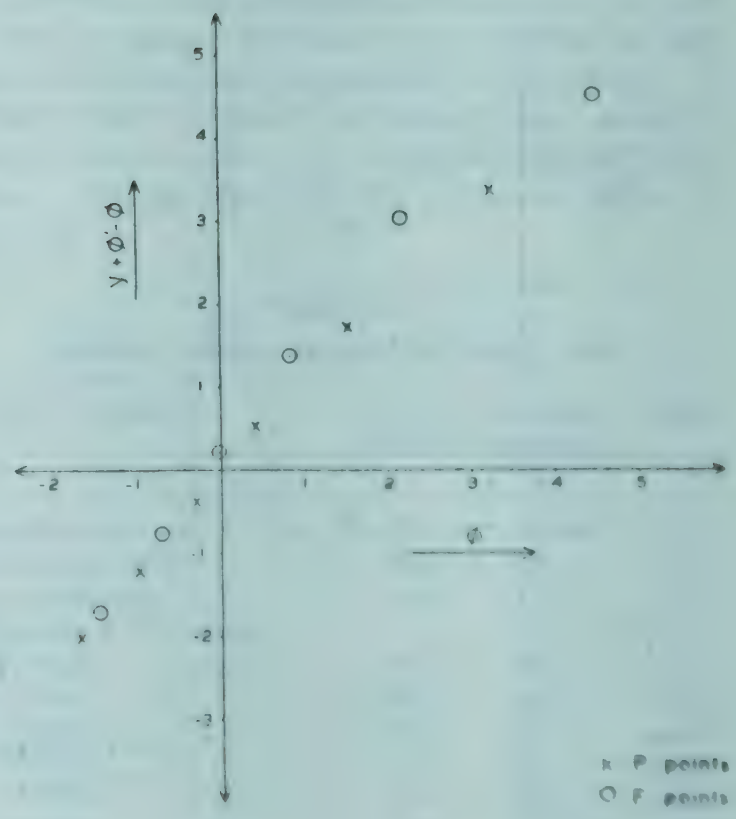


CHART - 21

PLOT OF P & F POINTS
MAHARASHTRA



2.26 A comparison of the estimates by P/F method with the corresponding SRS estimates shows that these are quite consistent with each other with regard to both level as well as pattern of fertility. The SRS estimates are found to be 25.2 for crude birth rate, 95.2 for general fertility rate and 2.9 for total fertility rate.

(X) MADHYA PRADESH

2.27 The values of P and F points are shown in table 21.

TABLE 21

Values of P and F points for Madhya Pradesh

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19	—1.8762	—1.7438	—1.5006	—1.4501
20—24	—1.0361	—1.0157	—0.7042	—0.7430
25—29	—0.2836	—0.3355	0.1546	—0.03 82
30—34	0.5524	0.4391	1.0534	0.8356
35—39	2.1782	1.5117	2.4233	2.1649
40—44	5.5328	3.2105	3.9224	4.4564

The P and F points are plotted in chart 19. By and large, the 'P' points and 'F' points appear to be approximately on the same straight line. The 'P' points on the extreme right give the impression of curving upwards which may be due to omission of children ever born by older women. On the other hand, the 'F' points on the extreme right give the impression of curving downwards which may be an indication of age misreporting among older women.

2.28 Table 22 shows estimated fertility indicators by P/F method and relational Gompertz model alongwith the corresponding SRS estimates. The estimates of birth rate, general fertility rate and total fertility rate by P/F method are almost the same as the corresponding estimates by relational Gompertz model. The estimates in the former case, are 38.7, 168.0 and 5.5 respectively; whereas the estimates in the latter case are 38.9, 169.3 and 5.6 respectively. In comparison, the SRS estimates are 37.2, 161.7 and 5.3 respectively which are not very much different. The estimated age specific fertility rates by P/F method and from SRS follow almost the same pattern. The estimates by relational Gompertz model also follow a similar pattern. The age specific fertility rates are shown in chart 20.

TABLE 22

Estimated fertility indicators for Madhya Pradesh, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate	38.7	38.9	37.2
General fertility rate	168.0	169.3	161.7
Total fertility rate	5.5	5.6	5.3
Age specific fertility rates			
15—19 years	155.5	129.4	132.3
20—24 years	293.4	295.6	298.5
25—29 years	258.2	277.9	250.9
30—34 years	180.3	210.1	182.5
35—39 years	126.6	136.4	117.6
40—44 years	61.0	58.4	52.3
45—49 years	15.7	7.3	17.1

(XI) MAHARASHTRA

2.29 The values of P and F points are shown in table 23.

TABLE 23

Values of P and F points for Maharashtra

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19	—2.0400	—1.7438	—1.7496	—1.4501
20—24	—1.2487	—1.0157	—0.7614	—0.7430
25—29	—0.3996	—0.3355	0.2023	—0.0382
30—34	0.5087	0.4391	1.3764	0.8356
35—39	1.7438	1.5117	3.0364	2.1649
40—44	3.3931	3.2105	4.5294	4.4564

Chart 21 shows the 'P' and 'F' points. All the 'F' points except one are found to be approximately on the same straight line. This 'F' line is different from the 'P' line on which all the 'P' points are found to lie. The 'P' line appears to have lower slope and smaller intercept than the 'F' line. The fertility may be declining in this case.

2.30 In case of a declining fertility, the level of fertility estimated by relational Gompertz model is likely to be on the higher side. Table 24 shows that the estimates of crude birth rate, general fertility rate and total fertility rate by relational Gompertz model are considerably higher than the corresponding estimates by P/F method. The crude birth rate by relational Gompertz model is found to be 32.8 as compared to 27.5 by P/F method. The general fertility rate and total fertility rate are respectively 136.6 and 4.5 by relational Gompertz model and 114.3 and 3.6 by P/F method. The age specific fertility rates as estimated by the two methods are also found to follow different patterns. In case of relational Gompertz model, the fertility rate is found to be the highest for age group

25-29 years as compared to the age group 20-24 years in case of P/F method. Except for the extreme age groups on either side, the rates in the former case are higher than those in the latter case and the differences are more in respect of older age groups than the younger age groups. It is likely that reduction in fertility has occurred among older women by curtailing higher order births. For the extreme age groups, the rates estimated by the relational Gompertz model have generally been found to be lower than those estimated by P/F method and the same is observed in this case also. The age specific fertility rates are shown in chart 22.

TABLE 24

Estimated fertility indicators for Maharashtra, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . .	27.5	32.8	26.9
General fertility rate .	114.3	136.6	112.0
Total fertility rate . .	3.6	4.5	3.5
Age specific fertility rates			
15—19 years . . .	87.1	65.5	82.3
20—24 years . .	235.9	243.9	238.3
25—29 years . . .	194.8	252.8	190.4
30—34 years . . .	117.7	199.4	115.6
35—39 years . . .	58.5	90.6	53.1
40—44 years . . .	20.0	38.0	20.3
45—49 years . . .	5.6	3.5	4.6

2.31 A comparison with the SRS estimates indicates that the estimates by P/F method are quite close to SRS estimates of 26.9 for crude birth rate, 112.0 for general fertility rate and 3.5 for total fertility rate. Also, the age pattern of fertility as indicated by the corresponding estimated age specific fertility rates is found to be consistent with that of P/F method.

(XII) ORISSA

2.32 The values of P and F points are shown in table 25.

TABLE 25

Values of P and F points for Orissa

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—2.0454	—1.7438	—1.7822	—1.4501
20—24 . .	—1.2757	—1.0157	—0.8706	—0.7430
25—29 . .	—0.3447	—0.3355	—0.0467	—0.0382
30—34 . .	0.5727	0.4391	0.9856	0 8356
35—39 . .	1.7659	1.5117	2.7855	2.1649
40—44 . .	..	3.2105	4.1943	4.4564

The plots of 'P' and 'F' points are shown in chart 23. The chart shows only 5 'P' points. The sixth point corresponding to ratio of the average parities for age groups 40-44 and 45-49 years could not be plotted as the average parity for age group 45-49 years was found to be less than the average parity for the age group 40-44 years. This may possibly be due to omission of children ever born in respect of women aged 45-49 years. The 'P' points and all the 'F' points except one seem to be on the same straight line. The last 'F' point on the right falls below this line and this seems to indicate misreporting of ages among older women.

2.33 Table 26 shows close agreement between the estimates obtained by P/F method with those obtained by relational Gompertz model with regard to both level as well as the age pattern of fertility. The estimates of crude birth rate, general fertility rate and total fertility rate are the same by both the methods and are 36, 147 and 4.9 respectively. The estimated age specific fertility rates by the two methods indicate similar pattern. However, the estimated rates for extreme age group on either side by relational Gompertz model are lower than those obtained by P/F method. The age pattern of fertility is shown in chart 24. In comparison to estimates by P/F method and relational Gompertz model, the SRS estimates are found to be 32.9 for crude birth rate, 134.5 for general fertility rate and 4.5 for total fertility rate. The SRS estimates are under-reported.

TABLE 26

Estimated fertility indicators for Orissa, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . .	36.4	36.0	32.9
General fertility rate . .	147.1	146.8	134.5
Total fertility rate . .	4.9	4.9	4.5
Age specific fertility rates			
15—19 years . . .	90.1	80.9	95.2
20—24 years . . .	278.7	279.7	261.0
25—29 years . . .	260.6	276.2	234.7
30—34 years . . .	192.2	194.0	163.8
35—39 years . . .	113.8	110.0	86.7
40—44 years . . .	34.5	34.5	25.6
45—49 years . . .	10.8	3.4	14.4

(XIII) PUNJAB

2.34 The values of P and F points are shown in table 27.

TABLE 27

Values of P and F points for Punjab

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—2.4169	—1.7438	—2.2783	—1.4501
20—24 . .	—1.6262	—1.0157	—1.1640	—0.7430
25—29 . .	—0.6636	—0.3355	—0.2382	—0.0382
30—34 . .	0.2470	0.4391	0.9877	0.8356
35—39 . .	1.7130	1.5117	2.4321	2.1649
40—44 . .	2.0989	3.2105	3.8076	4.4564

CHART-22

FERTILITY PATTERN BY AGE
MAHARASHTRA

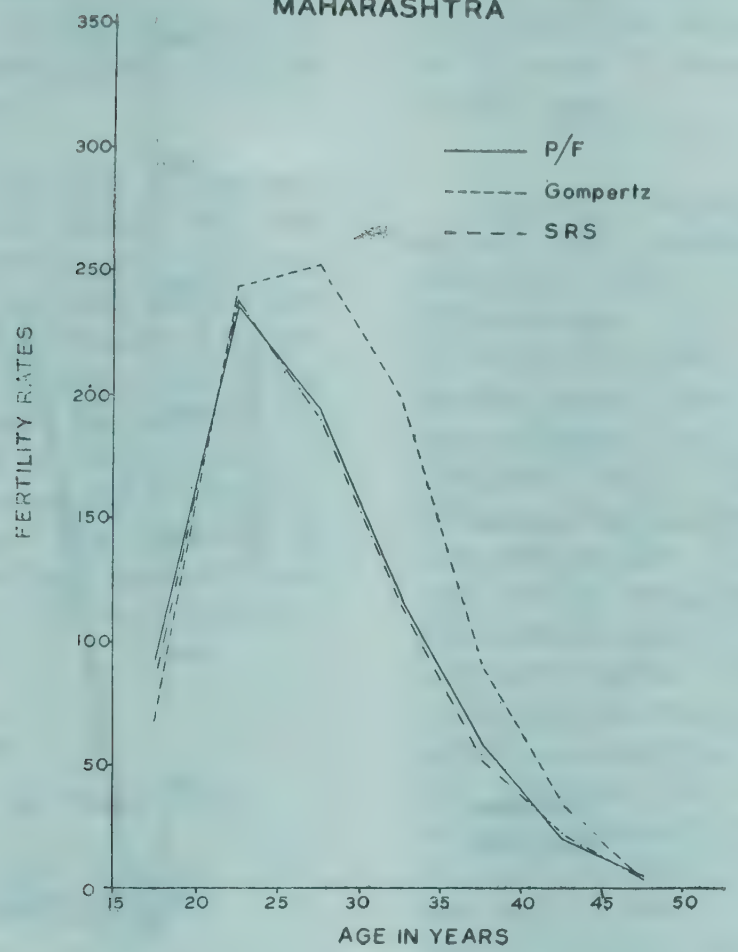


CHART-23

PLOT OF P & F POINTS
ORISSA

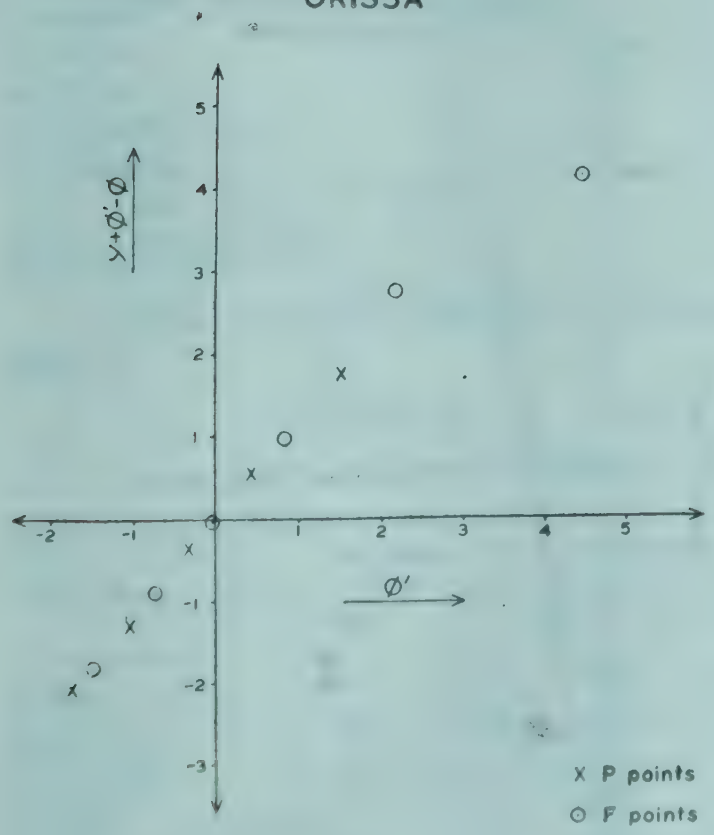


CHART-24

FERTILITY PATTERN BY AGE
ORISSA

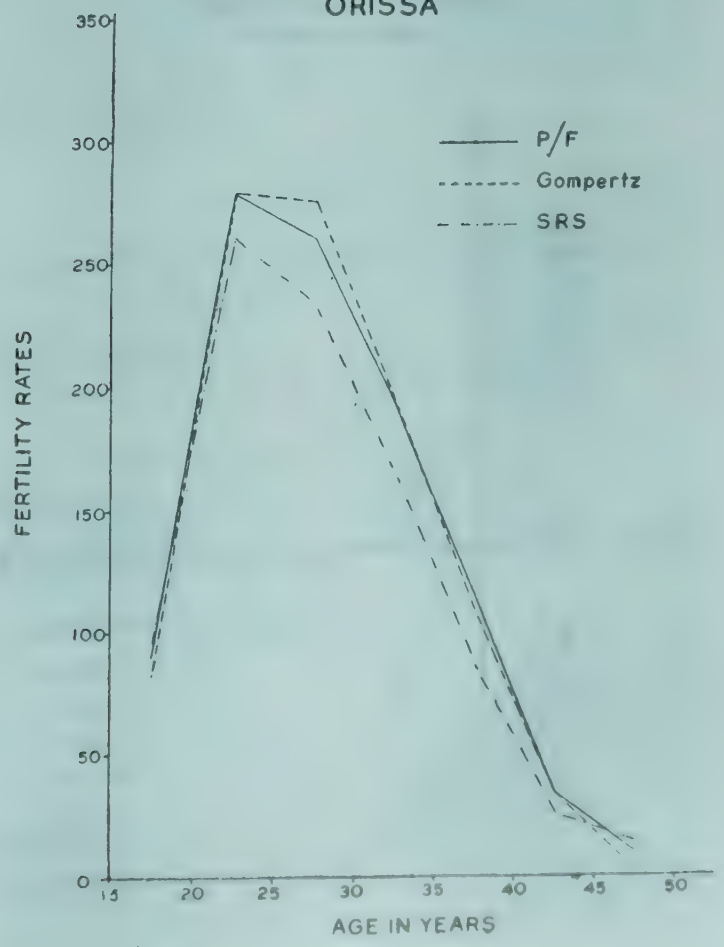


CHART-25
PLOT OF P & F POINTS
PUNJAB

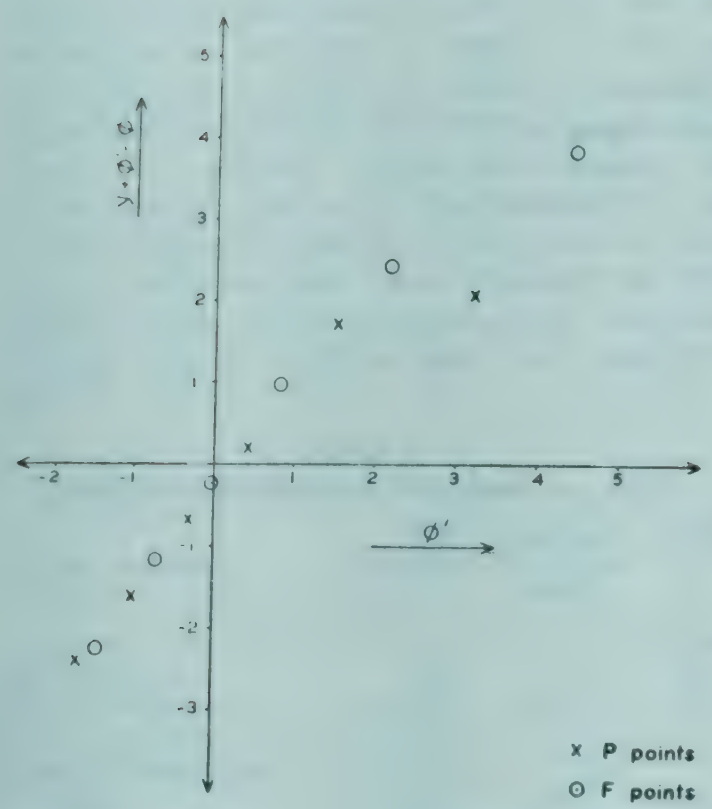


CHART-26
FERTILITY PATTERN BY AGE
PUNJAB

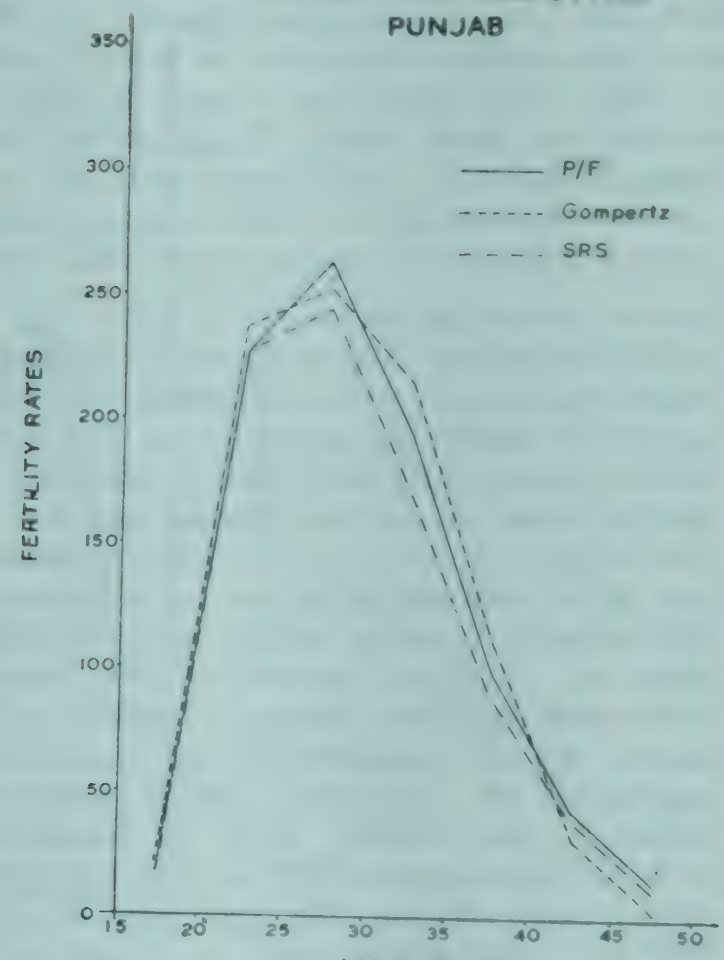


CHART-27
PLOT OF P & F POINTS
RAJASTHAN

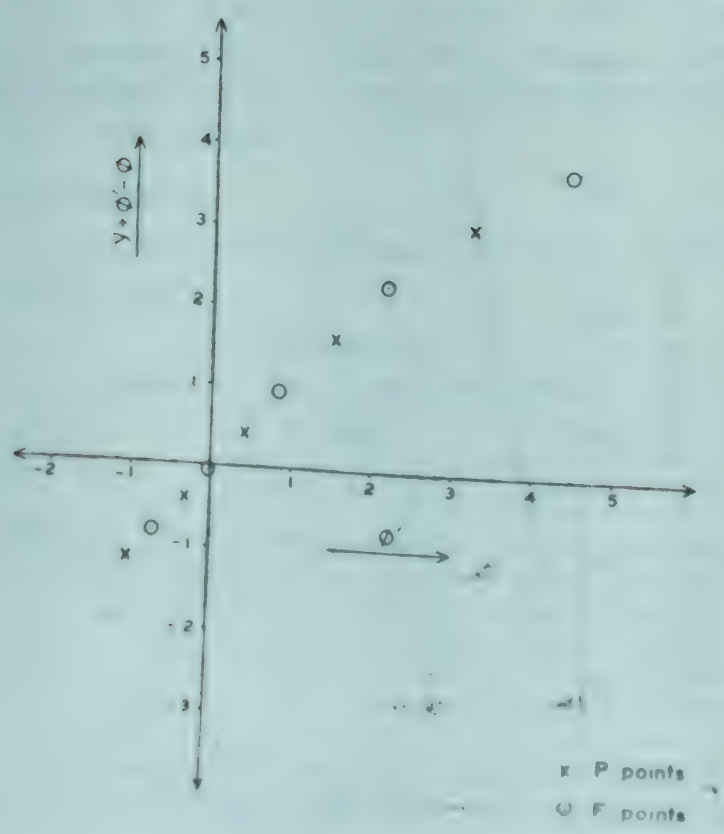


CHART-28
FERTILITY PATTERN BY AGE
RAJASTHAN

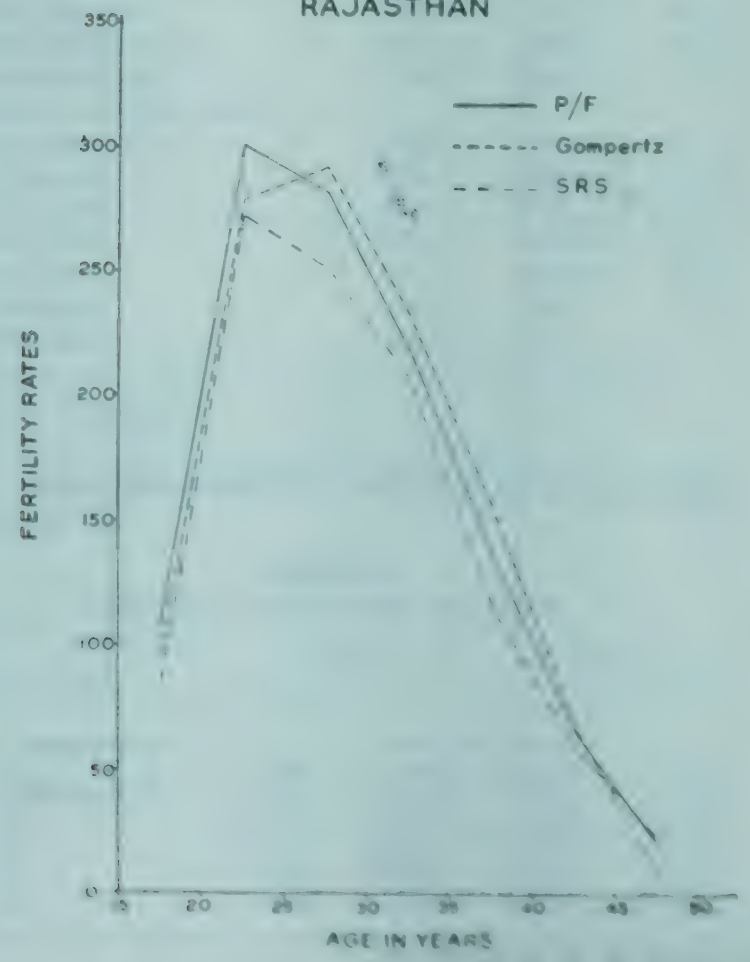


Chart 25 shows that except for one 'P' point and one 'F' point on the extreme right, all the other points are approximately on the same straight line. The two points on the extreme right are well below this straight line which may be due to age misreporting at older ages.

2.35 It may be seen from table 28 that estimated levels of fertility by P/F method and relational Gompertz model are very close. The estimates of crude birth rate by the two methods are 31.5 and 31.7 respectively. The estimates of general fertility rate are 133.2 and 134.1 respectively. The total fertility rate is 4.3 by both the methods. In comparison, the SRS estimates are found to be 29.4 for crude birth rate, 124.7 for general fertility rate and 4.0 for total fertility rate. The estimated age specific fertility rates in all the three cases are found to indicate similar pattern. The age pattern of fertility is shown in chart 26.

TABLE 28

Estimated fertility indicators for Punjab, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate	31.5	31.7	29.4
General fertility rate	133.2	134.1	124.7
Total fertility rate	4.3	4.3	4.0
Age specific fertility rates			
15—19 years	26.9	19.5	22.6
20—24 years	226.4	237.8	226.5
25—29 years	263.1	252.4	244.5
30—34 years	192.9	213.6	170.0
35—39 years	99.3	111.9	89.0
40—44 years	43.3	32.4	39.4
45—49 years	14.2	2.1	10.4

(XIV) RAJASTHAN

2.36 The values of P and F points are given in table 29.

TABLE 29

Values of P and F points for Rajasthan

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19	—1.9913	—1.7438	—1.7252	—1.4501
20—24	—1.1700	—1.0157	—0.8466	—0.7430
25—29	—0.4180	—0.3355	—0.0709	—0.0382
30—34	0.4373	0.4391	0.9415	0.8356
35—39	1.6055	1.5117	2.2812	2.1649
40—44	3.0396	3.2105	3.7046	4.4564

The P and F points are plotted in chart 27. It may be seen that the 'P' and 'F' points lie on the same straight line. Only two points are found to be out of line, which include one 'P' point and one 'F' point. This may be due to age misreporting at older ages.

2.37 The estimated fertility indicators by P/F method and relational Gompertz model are presented in table 30 alongwith the corresponding SRS estimates. The level of fertility indicated by the crude birth rate, general fertility rate or total fertility rate is found to be close as per the estimates obtained by P/F method and relational Gompertz model. The crude birth rate is found to be 39.6 by P/F method and 39.1 by relational Gompertz model. The general fertility rate and total fertility rate are respectively 173.6 and 5.7 by P/F method and 172.0 and 5.7 by relational Gompertz model. The SRS estimates are found to be 35.5 for crude birth rate, 155.8 for general fertility rate and 5.1 for total fertility rate. The SRS estimates are under-reported. In case of relational Gompertz model, the age specific fertility rates are found to be lower than the corresponding estimates by P/F method for the age-groups 15-19 and 20-24 years on one side and the age group 45-49 years on the other side. For the central age groups, the fertility rates are higher in the former case than in the latter case. The SRS estimates are found to follow almost the same pattern as the corresponding estimates by P/F method, but the estimates in the former case are lower than those in the latter case except for age group 45-49 years. The age pattern of fertility is shown in chart 28.

TABLE 30

Estimated fertility indicators for Rajasthan, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate	39.6	39.1	35.5
General fertility rate	173.6	172.0	155.8
Total fertility rate	5.7	5.7	5.1
Age specific fertility rates			
15—19 years	107.3	96.2	86.4
20—24 years	301.3	278.8	272.5
25—29 years	282.1	291.9	251.6
30—34 years	218.0	232.6	207.0
35—39 years	135.8	155.4	118.0
40—44 years	65.0	67.4	59.3
45—49 years	20.7	8.4	22.2

(XV) TAMIL NADU

2.38 The values of P and F points are shown in table 31.

TABLE 31

Values of P and F points for Tamil Nadu

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—2.0507	—1.7438	—1.7926	—1.4501
20—24 . .	—1.2715	—1.0157	—0.8617	—0.7430
25—29 . .	—0.3885	—0.3355	—0.0833	—0.0382
30—34 . .	0.4835	0.4391	1.1566	0.8356
35—39 . .	2.4244	1.5117	2.8961	2.1649
40—44 . .	4.3593	3.2105	4.3850	4.4564

Chart 29 shows the plots of 'P' and 'F' points. The 'F' points except the one on the extreme right appear to be approximately on the same straight line. The 'P' points except the two on the extreme right seem to lie on some other line which has slightly smaller slope and lower intercept than the 'F' line which may be due to declining fertility. Deviations of 'P' and 'F' points on the extreme right from the general patterns followed by the rest of the points may be due to reporting errors for older age groups of women. There may be omission of children ever born by older women. In the other case, there may be misreporting of age among older women.

2.39 Table 32 shows the estimated fertility indicators by P/F method and relational Gompertz model alongwith the corresponding SRS estimates. The estimated crude birth rate is found to be 31.9 by P/F method, 33.9 by relational Gompertz model and 28.8 from SRS. The corresponding estimates of general fertility rate are respectively 124.6, 132.1 and 112.2. The estimates of total fertility rate in the same order are 3.9, 4.2 and 3.5. Thus the estimates by P/F method are higher than the SRS estimates and the estimates by relational Gompertz model are higher than both. The SRS estimate is under-reported. In case of a declining fertility, the estimates by relational Gompertz model are likely to be on the higher side. A comparison of the age specific fertility rates indicates that the estimates by P/F method and from SRS follow similar pattern, though the age-wise rates in the former case are higher than those in the latter case. The estimates by relational Gompertz model follow a different pattern. In this case, the peak age group is found to be 25-29 years as compared to 20-24 years in the other two cases. Except for the extreme age groups on either side, the estimated rates by relational Gompertz model are higher than those obtained by P/F method and from SRS. The age pattern of fertility is shown in chart 30.

TABLE 32

Estimated fertility indicators for Tamil Nadu, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . . .	31.9	33.9	28.8
General fertility rate .	124.6	132.1	112.2
Total fertility rate. . .	3.9	4.2	3.5
Age specific fertility rates			
15—19 years . . .	77.3	57.5	75.1
20—24 years . . .	241.3	242.4	214.8
25—29 years . . .	219.8	250.1	203.2
30—34 years . . .	140.6	173.2	127.7
35—39 years . . .	78.7	94.4	60.4
40—44 years . . .	25.0	30.7	20.1
45—49 years . . .	7.0	2.4	5.1

(XVI) UTTAR PRADESH

2.40 The values of P and F points are shown in table 33.

TABLE 33

Values of P and F points for Uttar Pradesh

Age group	P points		F points	
	$y+\phi'-\phi$	ϕ'	$y+\phi'-\phi$	ϕ'
15—19 . .	—2.0107	—1.7438	—1.7319	—1.4501
20—24 . .	—1.2501	—1.0157	—0.9508	—0.7430
25—29 . .	—0.3804	—0.3355	—0.1508	—0.0382
30—34 . .	0.4881	0.4391	0.7472	0.8356
35—39 . .	1.9085	1.5117	2.0041	2.1649
40—44 . .	3.1595	3.2105	3.2109	4.4564

The plots of 'P' and 'F' points are shown in chart 31. Most of the 'P' and 'F' points are seen to be approximately on the same straight line. The points on the extreme right corresponding to older age-groups are found to be out of line possibly because of some reporting errors in respect of data for older women.

2.41 The estimated level of fertility by P/F method is found to be close to that obtained by relational Gompertz model. From table 34 the estimated crude birth rate is found to be 42.5 in the former case and 42.8 in the latter case. The general fertility rate and total fertility rate are respectively 187.3 and 6.3 in the former case and

CHART-29

PLOT OF P & F POINTS
TAMIL NADU

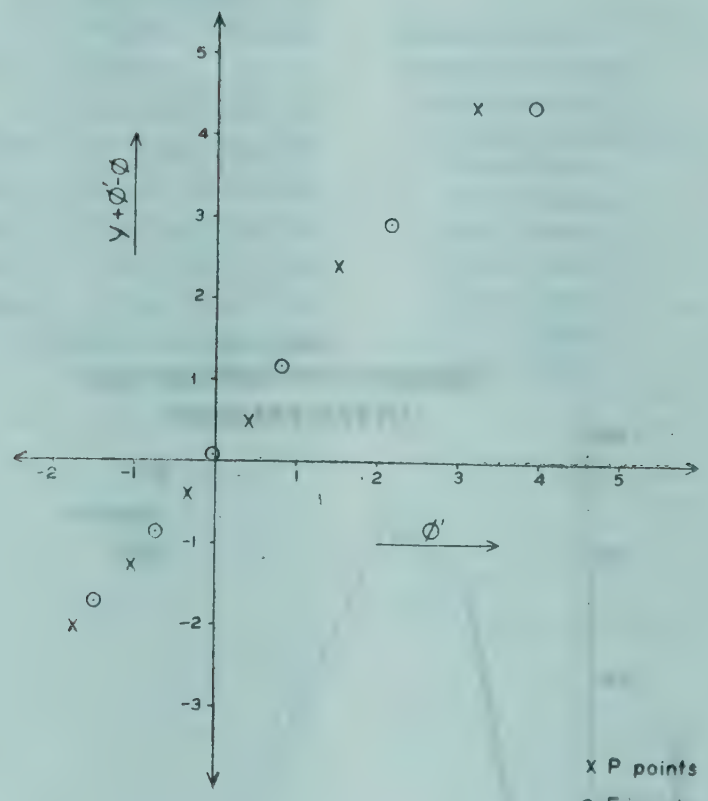


CHART-30

FERTILITY PATTERN BY AGE
TAMIL NADU

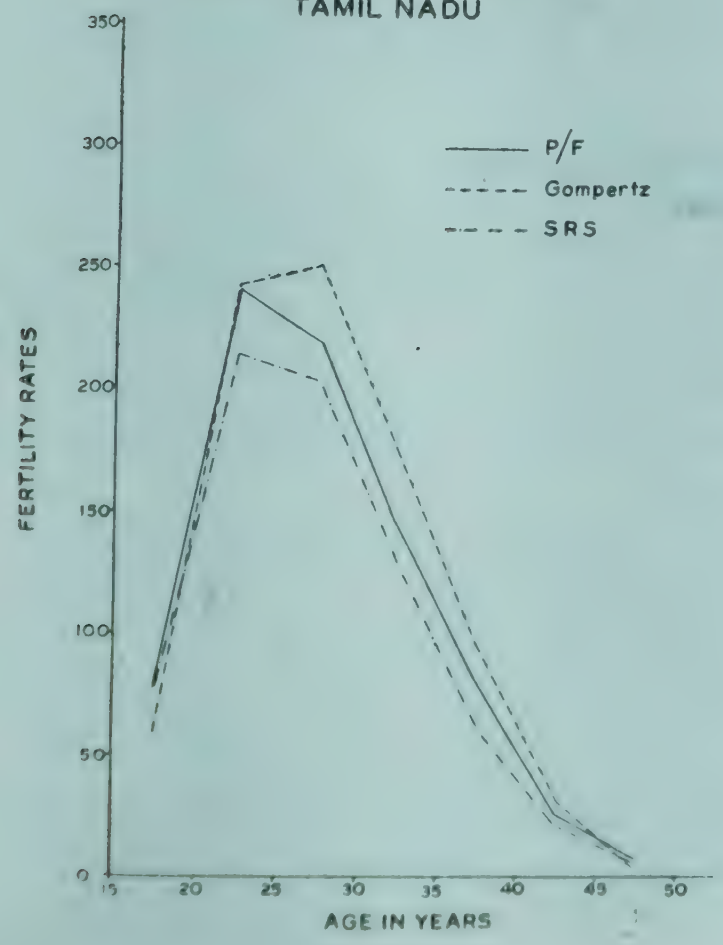


CHART - 31

PLOT OF P & F POINTS
UTTAR PRADESH

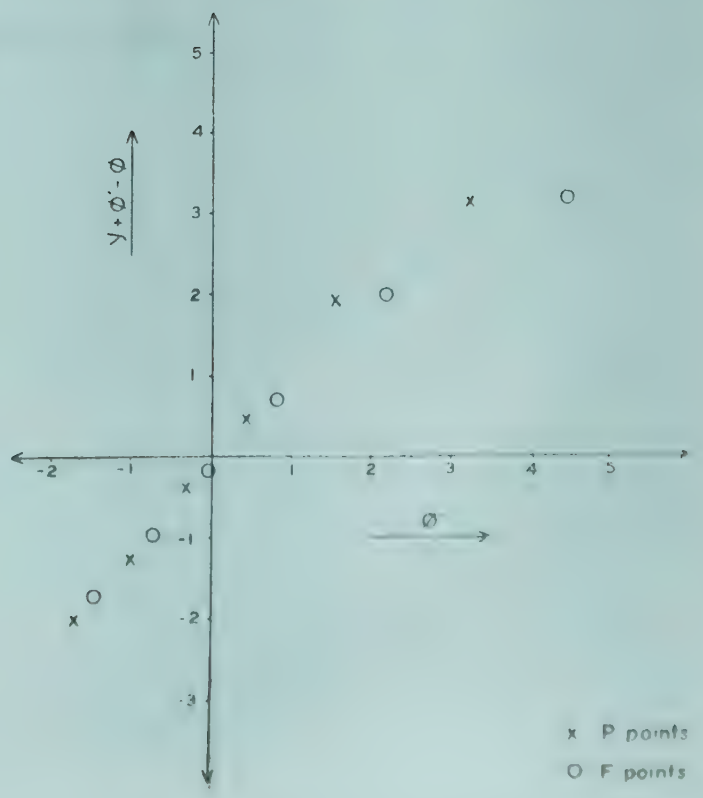
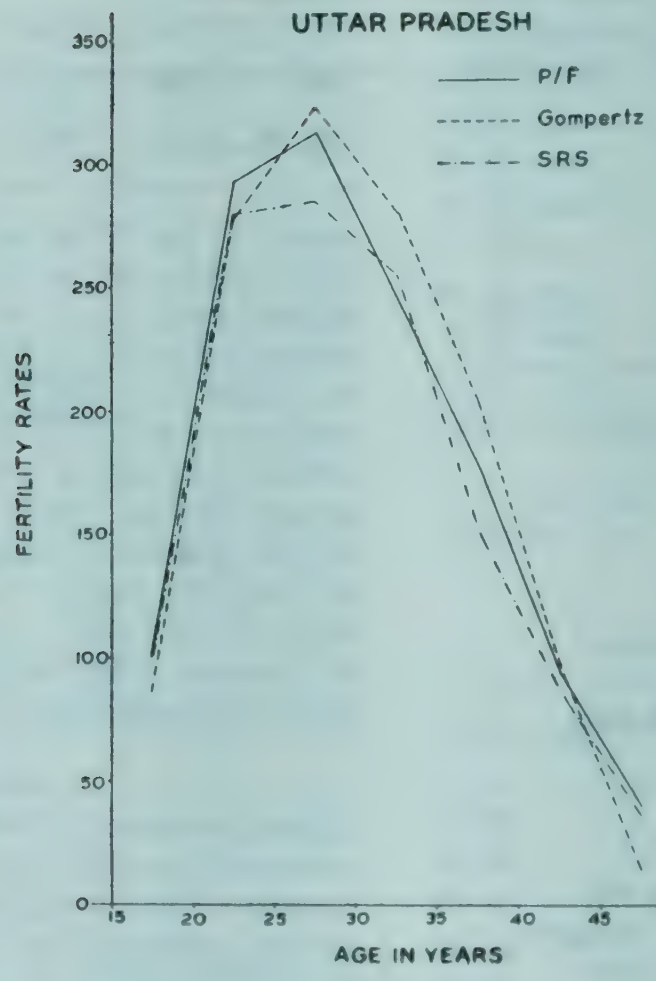


CHART - 32

FERTILITY PATTERN BY AGE

UTTAR PRADESH



188.6 and 6.4 in the latter case. The age patterns of fertility as indicated by the estimated age specific fertility rates are found to be similar in both the cases. SRS estimates of age specific fertility rates are found to follow almost the same pattern as the corresponding estimates by P/F method, though the estimates in the former case are lower than the estimates in the latter case. The overall level of fertility as indicated by crude birth rate, general fertility rate or total fertility rate is therefore found to be lower in the former case than in the latter case. The SRS estimates for the above three indicators are respectively 40.4, 178.0 and 6.0. The age pattern of fertility is shown in chart 32.

TABLE 34

Estimated fertility indicators for Uttar Pradesh, 1978

Fertility indicators	P/F method	Relational Gompertz model	SRS
Crude birth rate . . .	42.5	42.8	40.4
General fertility rate . .	187.3	188.6	178.0
Total fertility rate . .	6.3	6.4	6.0
Age specific fertility rates .			
15—19 years . . .	100.3	85.8	99.6
20—24 years . . .	293.0	277.7	279.3
25—29 years . . .	312.7	322.7	284.1
30—34 years . . .	246.3	281.0	254.3
35—39 years . . .	177.1	204.4	151.9
40—44 years . . .	94.1	97.8	87.6
45—49 years . . .	39.9	14.0	35.4

Chapter 3

ESTIMATES OF INFANT AND CHILD MORTALITY

Brass and Trussel methods enable conversion of proportion of children dead, D(i), in respect of i th age group of women into probability of dying before attaining certain exact childhood age x denoted by q(x), where i = 1, 2,. .....7 corresponds to age groups 15-19, 20-24,.....45-49 years respectively and x = 1, 2, 3, 5, 10, 15 and 20. The estimated values of q(x) and l(x) = 1—q(x) obtained by the two methods are presented and discussed in this chapter. The corresponding 'levels' in the Coale-Demney West Model Life Table System are also presented alongwith these estimates. In case of changing mortality, it would be useful to know the corresponding time reference period for each of the estimates of q(x), l(x) values. Hence the estimates of time reference period are also presented alongwith the corresponding q(x), l(x) values.

3.1 The q(1) values calculated by both the methods are based on the proportion of children dead in respect of women in the age group 15-19 years. Usually the number of births pertaining to this age group of women is very small. Accordingly, the q(1) values are subject to random fluctuations. Also, most of the children in this age group may be of first birth order which in relation to young age of mothers may tend to inflate the mortality experienced by them. Thus, the q(1) values are likely to be on the higher side. On the other hand, the estimates of q(x) for higher values of x are likely to on the lower side as in case of older women there may be reporting errors due to recall lapse affecting the proportion of children dead. The chances of omission of children dead while reporting the number of children ever born and the number surviving is likely to increase with increase in age of women because of the time lag involved between the occurrence of an event and its reporting. Generally, the q(2) value is considered more reliable than the rest of the q(x) values. Hence in order to estimate the mortality during infancy and early childhood, the 'level' of mortality has been considered to be the same as indicated by the q(2) value and the age pattern of mortality has been assumed to be similar to that of West Model Life Table System. In this way a set of estimates for infant mortality rate and child mortality rate in respect of age group 0-4 years has been obtained and these are also presented and discussed in this chapter. The broad findings are given in the succeeding paras.

Broad Findings

3.2 It has been mentioned earlier that the estimates of q(2) values are generally considered to be more reliable than the estimates for the rest of the q(x) values. Table 35 shows the estimated q(2) values for India and major states. The estimates by Brass and Trussel methods are found to be the same. At all-India level, the values are found to be 0.1552 and 0.1584 by Brass and Trussel methods respectively. These indicate that out of a 1000 live born children, approximately 160 are likely to die before completion of age 2 years or in other words, approximately 840 are likely to survive till the completion of exact age 2 years. Among the states, the q(2) values are found to be the lowest in Kerala and the highest in Uttar Pradesh. In respect of Kerala q(2) values are found to indicate that out of 1000 live born children, around 55 are likely to die before completion of exact age 2 years, that is around 945 children out of a thousand live born babies are likely to survive till the completion of exact age 2 years. The q(2) values for Uttar Pradesh indicate that approximately 210 out of a thousand live born children are likely to die between birth and exact age 2 years, or in other words, approximately 790 out of a thousand would live till the completion of 2 years of life.

TABLE 35

Estimated q(2) values by Brass and Trussel methods for India and major states

India/States	Brass	Trussel
INDIA	0.1552	0.1584
Andhra Pradesh	0.1516	0.1515
Assam	0.1176	0.1170
Gujarat	0.1846	0.1867
Haryana	0.1396	0.1437
Himachal Pradesh	0.1306	0.1318
Jammu & Kashmir	0.1182	0.1217
Karnataka	0.1168	0.1208
Kerala	0.0521	0.0576
Madhya Pradesh	0.1963	0.1967
Maharashtra	0.1146	0.1165
Orissa	0.1852	0.1885
Punjab	0.1198	0.1226
Rajasthan	0.1600	0.1619
Tamil Nadu	0.1317	0.1342
Uttar Pradesh	0.2080	0.2125

3.3 If the statewise q(2) values are expressed in terms of the q(2) values at all-India level, then the following classification of states emerges irrespective of whether the q(2) values have been calculated by Brass method or Trussel method.

Statewise q(2) values expressed as percentages of all-India q(2) value	States
Below 40	Kerala
40—60	..
60—80	Assam, Jammu & Kashmir, Karnataka, Maharashtra, Punjab.
80—100	Andhra Pradesh, Haryana, Himachal Pradesh, Tamil Nadu.
More than 100	Gujarat, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh.

It is observed that the levels of mortality in five states, viz., Gujarat, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh as indicated by the corresponding q(2) values are higher than the all-India average. In the remaining states, the levels of mortality are lower than the all-India average. Kerala is the only state, where the level of mortality is even less than 40 per cent of the all-India average.

3.4 The estimated infant mortality rates for India and major states corresponding to the 'levels' of mortality indicated by the q(2) values are given in table 36. The SRS estimates for the year 1978 are also shown. It is observed that the estimates by the two methods at all-India level are close to SRS estimates. The estimates for Andhra Pradesh, Haryana and Himachal Pradesh are also comparable with the SRS estimates. In Madhya Pradesh, Orissa, Punjab, Rajasthan and Uttar Pradesh the computed estimates lie around 10 per cent of the SRS estimate. In the case of Jammu & Kashmir and Karnataka the SRS estimates appear to be under-reported. In Kerala the SRS estimates are lower than the computed estimates as there is evidence of a decline in mortality. In Maharashtra and Tamil Nadu, there is indication of a declining fertility in which case the computed infant and child mortality rates by Brass and Trussel methods are likely to be on the higher side.

TABLE 36

Estimated infant mortality rates for India and major states

India/States	Brass method	Trussel method	SRS (1978)
INDIA	125 (98.4)	128 (100.8)	127 (100.0)
Andhra Pradesh	122 (104.3)	122 (104.3)	117 (100.0)
Assam	94 (79.7)	96 (81.4)	118 (100.0)
Gujarat	147 (120.5)	148 (121.3)	122 (100.0)

TABLE 36—*Concld.*

India/States	Brass method	Trussel method	SRS (1978)
Haryana	113 (103.7)	116 (106.4)	109 (100.0)
Himachal Pradesh	106 (104.9)	108 (106.9)	101 (100.0)
Jammu & Kashmir	96 (131.5)	100 (137.0)	73 (100.0)
Karnataka	95 (115.8)	99 (120.7)	82 (100.0)
Kerala	49 (116.7)	50 (119.0)	42 (100.0)
Madhya Pradesh	156 (109.1)	156 (109.1)	143 (100.0)
Maharashtra	94 (116.0)	95 (117.3)	81 (100.0)
Orissa	147 (110.5)	150 (112.8)	133 (100.0)
Punjab	106 (90.6)	109 (93.2)	117 (100.0)
Rajasthan	129 (92.1)	129 (92.1)	140 (100.0)
Tamil Nadu	122 (116.1)	123 (117.1)	105 (100.0)
Uttar Pradesh	163 (92.1)	165 (93.2)	177 (100.0)

Figures in the parentheses indicate percentages in terms of SRS estimates.

3.5 The distribution of states classified by the ratio of the computed infant mortality rates by Brass/Trussel method to the corresponding SRS estimates expressed as a percentage is presented below.

Percentages	Brass Method	Trussel method
Less than 90	Assam	Assam
90—100	India, Punjab, Rajasthan and Uttar Pradesh.	Punjab, Rajasthan and Uttar Pradesh.
100—110	Andhra Pradesh, Haryana, Himachal Pradesh and Madhya Pradesh.	India, Andhra Pradesh, Haryana, Himachal Pradesh and Madhya Pradesh.
110—120	Karnataka, Kerala, Maharashtra, Orissa and Tamil Nadu	Kerala, Maharashtra, Orissa and Tamil Nadu.
120 & above	Gujarat and Jammu & Kashmir.	Gujarat, Jammu and Kashmir and Karnataka.

Barring certain states where there is indication of a decline in fertility/mortality or reporting errors in the number of children dead, in a majority of states computed estimates lie within 10 per cent of the SRS estimates.

3.6 The mortality rates for children below 5 years as calculated by Brass and Trussel methods are given in table 37 along with SRS estimates for 1978. The three sets of estimates are found to be reasonably comparable at all-India level and also in respect of states like Andhra Pradesh, Haryana, Jammu & Kashmir, Kerala and Maharashtra. In case of Assam and Rajasthan the rates calculated by Brass and Trussel method are found to be much

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lower than the SRS estimates for 1978. In Gujarat, Himachal Pradesh, Orissa and Tamil Nadu the SRS estimates are appreciably lower than the estimates obtained by Brass and Trussel methods. The accuracy of these estimates depend on the validity of the assumption concerning the choice of West Model Life Table.

TABLE 37

Mortality rates for children below 5 years for India and major states

India/States	Brass method	Trussel method	SRS (1978)
INDIA	45.6	45.7	48.3
	(94.4)	(94.6)	(100.0)
Andhra Pradesh . . .	43.0	43.0	44.2
	(97.3)	(97.3)	(100.0)
Assam	30.4	31.4	41.9
	(72.5)	(74.9)	(100.0)
Gujarat . . .	53.9	54.6	46.7
	(115.4)	(116.9)	(100.0)
Haryana	38.2	39.9	39.7
	(96.2)	(100.5)	(100.0)
Himachal Pradesh .	35.5	36.1	30.6
	(116.0)	(118.0)	(100.0)
Jammu & Kashmir . .	31.4	32.9	32.0
	(98.1)	(102.8)	(100.0)
Karnataka . . .	30.9	32.4	35.5
	(87.0)	(91.3)	(100.0)
Kerala	13.7	14.0	14.3
	(95.8)	(97.9)	(100.0)
Madhya Pradesh . . .	58.1	58.1	63.8
	(91.1)	(91.1)	(100.0)
Maharashtra . . .	30.4	30.9	32.8
	(92.7)	(94.2)	(100.0)
Orissa	53.8	55.2	45.9
	(117.2)	(120.3)	(100.0)
Punjab	34.2	35.3	40.8
	(83.8)	(86.5)	(100.0)
Rajasthan	45.6	45.6	63.3
	(72.0)	(72.0)	(100.0)
Tamil Nadu . . .	45.6	46.2	40.8
	(111.0)	(113.2)	(100.0)
Uttar Pradesh . . .	71.6	73.2	81.0
	(88.4)	(90.4)	(100.0)

— Figures in parentheses indicate percentages in terms of SRS estimates.

3.7 On the basis of child mortality rate calculated by Brass and Trussel methods expressed as percentages of SRS estimates for 1978, the following distribution emerges.

Percentages	Brass method	Trussel method
70—80 .	Assam, Rajasthan	Assam, Rajasthan
80—90 .	Karnataka, Punjab, Uttar Pradesh.	Punjab
90—100 .	India, Andhra Pradesh, Haryana, Jammu & Kashmir, Kerala, Madhya Pradesh, Maharashtra.	India, Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Uttar Pradesh.
100—110	..	Haryana, Jammu and Kashmir.
110—120	Gujarat, Himachal Pradesh, Orissa, Tamil Nadu.	Gujarat, Himachal Pradesh, Tamil Nadu.
120 & above	..	Orissa

The computed estimates of infant mortality and child mortality as obtained by Brass and Trussel methods and the SRS estimates are plotted in charts 33 and 34.

Detailed results

(I) INDIA

3.8 The mortality levels using Brass and Trussel methods are presented in table 38. The estimates of q(x), l(x) values and the corresponding 'levels' from Coale-Demney West Model Life Table System are found to be almost the same by the two methods. The estimates of q(1) are found to be very high. The corresponding 'levels' are very much different from those corresponding to the other q(x) values. The estimates of q(1) are based on the proportion of children dead among children ever born to women in the age group 15-19 years which is affected by random fluctuations because of small number of events involved. Also most of these children are of first birth order which in relation to the young age of mothers tends to inflate the level of mortality experienced by them. On the other extreme the q(x) values based on the mortality experiences of children in respect of women in the older age groups are likely to be affected by reporting errors due to recall lapse. Therefore, these estimates are likely to be on the lower side as observed in the present case.

TABLE 38

Mortality levels using Brass and Trussel methods, India

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0·1767	0·1789	0·8293	0·8211	10·3	9·8	1·0
2	0·1552	0·1584	0·8448	0·8416	13·3	13·1	2·2
3	0·1464	0·1468	0·8536	0·8532	14·4	14·4	4·0
5	0·1647	0·1671	0·8353	0·8329	13·5	13·3	6·1
10	0·1680	0·1695	0·8320	0·8305	14·7	13·6	8·5
15	0·1701	0·1731	0·8299	0·8269	15·1	14·9	13·2
20	0·1933	0·1954	0·8067	0·8046	14·7	14·6	14·2

CHART-33

ESTIMATES OF INFANT MORTALITY RATES FOR INDIA AND STATES

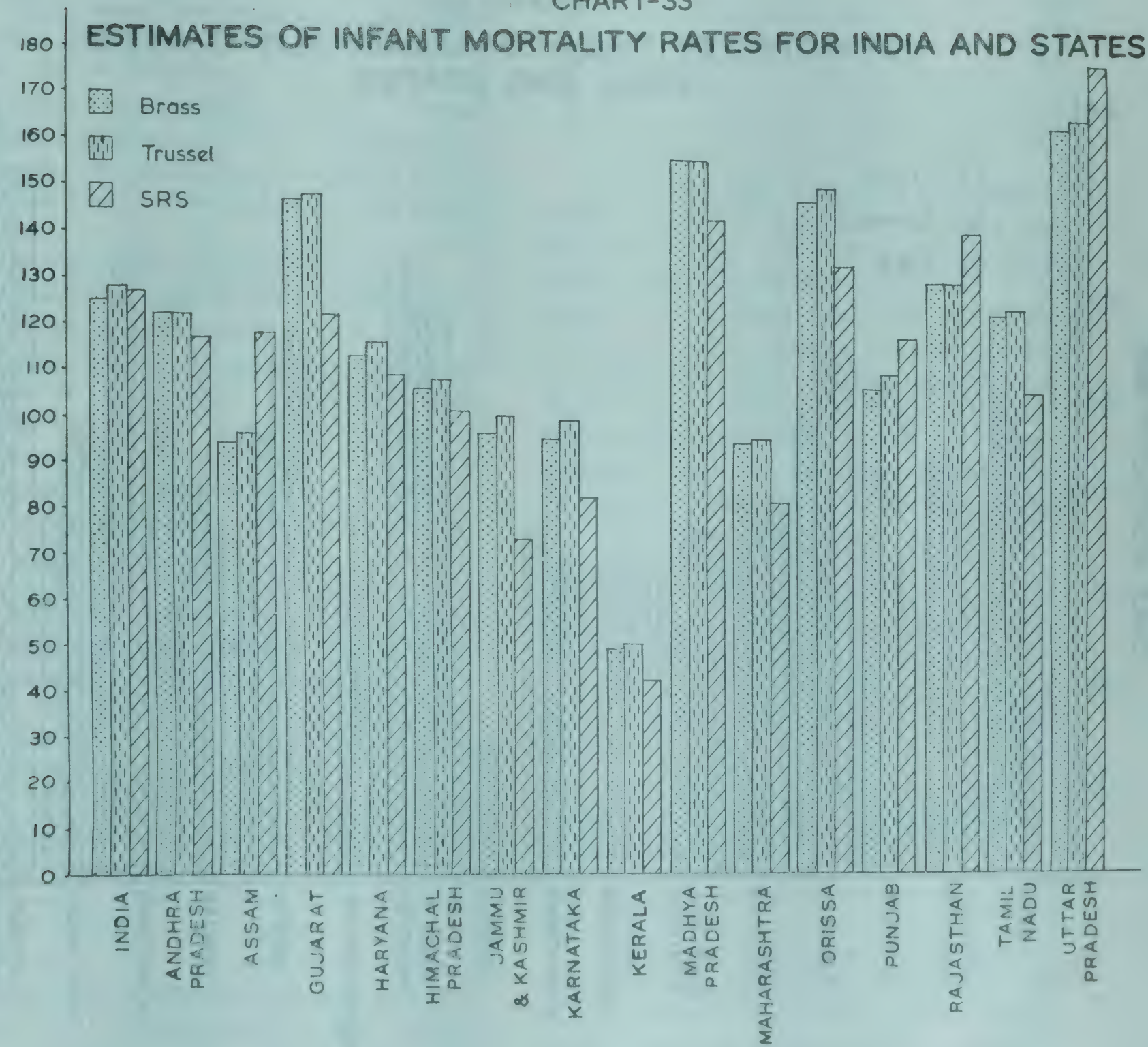


CHART-34

ESTIMATES OF CHILD (0-4) MORTALITY RATES INDIA AND STATES

3.9 For estimation of infant and early childhood mortality rate, the level of mortality is assumed to be the same as indicated by the estimated q(2) value and the age pattern of mortality may be assumed to be similar to the Coale-Demney West Model Life Table System. From table 38, it is observed that, the estimate of q(2) by Brass method is 0.1552 which corresponds to the 'level' 13.3 in the Coale-Demney West Model Life Table System. The values of q(1), q(3) and q(5) corresponding to this level are 0.1250, 0.1629 and 0.1843 respectively. The estimate of q(2) by Trussel method is found to be 0.1584. Corresponding to the level 13.1 identified for this value of q(2) in the Coale-Demney West Model Life Table System, the values of q(1), q(3) and q(5) are 0.1277, 0.1730 and 0.1889 respectively. The values of q(1) provide estimates of infant mortality rate as 125 in case of Brass method and 128 in case of Trussel method. These estimates are close to SRS estimate of 127 for 1978. The estimates of age specific death rate for 0-4 years based on the q(x) values are 45.6 and 45.7 respectively in case of Brass and Trussel methods. These estimates are close to the corresponding SRS estimate of 48.3.

(II) ANDHRA PRADESH

3.10 The values of q(x) and l(x) calculated by Brass and Trussel methods alongwith the corresponding 'levels' in the Coale-Demney West Model Life Table System are presented in table 39. The time reference period in terms of the number of years prior to the survey indicating the period to which each of the q(x) value relates is also given in the table. It is observed that the q(x), l(x) values estimated by Brass method and the corresponding 'levels' are almost the same as those obtained in case of Trussel method. The 'levels' for successive q(x) values are almost the same excepting those corresponding to q(1) and q(2) values. The levels corresponding to q(1) and q(2) values indicate higher mortality than those corresponding to subsequent q(x) values. Possibly, the mortality indicated by the latter q(x) values are on the lower side which may be due to reporting error affecting the proportion of children dead on which the q(x) values are based. Apparently the levels do not indicate any declining trend in mortality in this case.

TABLE 39

Mortality levels using Brass & Trussel methods, Andhra Pradesh

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0·1239	0·1323	0·8761	0·8672	13·4	12·8	0·9
2	0·1516	0·1515	0·8484	0·8485	13·5	13·5	2·3
3	0·1445	0·1406	0·8555	0·8594	14·5	14·8	4·5
5	0·1595	0·1561	0·8405	0·8439	14·4	14·6	7·0
10	0·1716	0·1693	0·8284	0·8307	14·5	14·6	9·8
15	0·1784	0·1777	0·8216	0·8223	14·7	14·7	12·7
20	0·1949	0·1930	0·8051	0·8070	14·6	14·7	15·6

3.11 If the level of mortality is assumed to be the same as indicated by the estimated q(2) value and the age pattern of mortality during infancy and early childhood is assumed to be similar to West Model Life Table System, the estimates of infant mortality rate and mortality rate during early childhood can be obtained. The values of q(2) estimated by Brass and Trussel methods are found to be 0.1516 and 0.1515 respectively, from table 39. These correspond to the same 'level', that is 13.5 in the West Model Life Table System. The values of q(1), q(3) and q(5) corresponding to this 'level' are 0.1222, 0.1648 and 0.1797 respectively. Thus the estimate of infant mortality rate is found to be 122.2 in case of both Brass and Trussel methods. This estimate is close to the SRS estimate of 117 for the year 1978. The mortality rate for age-group 0-4 years calculated on the basis of the above q(x) values is found to be 43.0 which also compares well with the corresponding SRS estimate of 44.2 for the year 1978.

(III) ASSAM

3.12 It may be seen from table 40 that the estimates of q(x) and l(x) for different values of x as obtained by Brass method are almost the same as the corresponding estimates obtained by Trussel method. Except q(1), the rest of q(x) values obtained by Brass or Trussel method correspond to almost the same 'level' in the Coale-Demney West Model Life Table System. The q(1) values correspond to a different 'level' in the Coale-Demney West Model Life Table System which represent higher mortality than the

corresponding 'levels' with which the rest of the q(x) values are identified. Presumably the q(1) values are on the higher side as these are based on the mortality experiences of children born to young mothers and mostly corresponding to births of first order. The q(1) values are also likely to be affected by random fluctuations because of small number of events involved. The q(2) values alongwith the rest of the q(x) values appear to be on the lower side in this case presumably because of reporting errors resulting in lower proportions of children dead on which the q(x) values are based. This is supported by the fact that there is a tendency for the mortality 'level' to increase in the older ages.

TABLE 40

Mortality levels using Brass and Trussel methods, Assam

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0·1266	0·1291	0·8734	0·8709	13·2	13·0	1·1
2	0·1136	0·1170	0·8864	0·8830	15·7	15·5	2·2
3	0·1252	0·1270	0·8748	0·8730	15·6	15·5	3·8
5	0·1328	0·1352	0·8672	0·8648	15·8	15·5	5·8
10	0·1423	0·1460	0·8577	0·8540	15·9	15·7	8·0
15	0·1422	0·1473	0·8578	0·8527	16·3	16·1	10·5
20	0·1562	0·1607	0·8438	0·8393	16·3	16·1	13·5

3.13 Generally, the q(2) value is considered to be more reliable than the rest of the q(x) values. However, in the present case, the q(2) value obtaind by both the methods are found to fall in line with the subsequent q(x) values and may be on the lower side on account of reporting errors resulting in lower proportions of children dead on which estimates are based. In that case, if the level of mortality is assumed to be the same as indicated by the q(2) values and the age pattern in infancy and early childhood conforms to the West Model Life Table System, the resultant estimates of infant and child mortality rates are likely to be on the lower side. It is observed from table 40 that, the 'levels' corresponding to q(2) values obtained by Brass and Trussel method are respectively 15.7 and 15.5. The values of q(1), q(3) and q(5) from the West Model Life Tables corresponding to these 'levels' are found to be 0.0940, 0.1237 and 0.1344 respectively in case of Brass method and 0.0965, 0.1273 and 0.1382 respectively in case of Trussel method. Therefore, the estimates of infant mortality rate obtained are 94.0 and 96.5 respectively in case of Brass and Trussel methods which are much lower than the corresponding SRS estimate of 118 for 1978. The corresponding mortality rates for age group 0-4 years are found to be 30.4 and 31.4 respectively in the case of Brass and Trussel methods. These are found to be lower than the SRS estimates of 41·9 for the year 1978. The SRS estimates of infant and child mortality rates appear to be reasonably alright as the q(2) values mentioned earlier are on the lower side.

(IV) GUJARAT

3.14 The estimates of q(x) and l(x) as obtained by Brass and Trussel methods are presented in table 41. The 'levels' in the West Model Life Tables are found to increase for successive higher values of x. There appears to be reporting errors in the number of children dead. The 'levels' corresponding to q(1) values represent situations where the mortality is high. The q(1) values are likely to be the higher side for reasons mentioned earlier.

TABLE 41

Mortality levels using Brass and Trussel methods, Gujarat

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0·2096	0·2204	0·7904	0·7796	8·1	7·5	0·7
2	0·1846	0·1867	0·8154	0·8133	11·8	11·7	1·8
3	0·1688	0·1663	0·8312	0·8337	13·3	13·4	3·6
5	0·1721	0·1696	0·8279	0·8304	13·8	13·9	5·8
10	0·1792	0·1804	0·8208	0·8196	14·2	14·1	8·4
15	0·1879	0·1865	0·8121	0·8135	14·3	14·3	11·2
20	0·2050	0·1990	0·7950	0·8010	14·2	14·5	14·3

3·15 Assuming the 'level' of mortality to be the same as that indicated by the q (2) values and the age pattern of mortality similar to the West Model Life Table System, the estimates of infant & child mortality rates have been worked out. From table 41, the 'levels' of q (2) values by Brass and Trussel methods are found to be 11.8 and 11.7 respectively. The values of q(1), q(3) and q(5) corresponding to these levels are 0.1469, 0.2[illegible]8 and 0.2196 respectively in case of Brass method and 0.1484, 0.2029 and 0.2220 respectively in case of Trussel method. The estimates of infant mortality rate are found to be 146.9 in case of Brass method and 148.4 in case of Trussel method. The SRS estimate of infant mortality rate for 1978 is 122. The estimated mortality rate for 0-4 years calculated on the basis of the q (x) values are found to be 53.9 and 54.6 respectively by Brass and Trussel methods. The SRS estimate is found to be 46.7 for 1978. Thus the estimates of infant and child mortality rates calculated by Brass and Trussel methods are found to be higher than the corresponding SRS estimates for 1978. If the level of mortality is assumed to be the same as

indicated by q(3) level, the computed infant and child mortality rates are close to SRS.

(V) HARYANA

3.16 Table 42 shows close similarity between the estimates of q(x), l(x) obtained by Brass and Trussel methods. The 'levels' corresponding to all the q (x) values except q (1) are almost the same. The time reference period shows the number of years prior to the survey to which a particular q(x) values relates. There appears to be no decline in mortality.

TABLE 42

Mortality levels using Brass and Trussel methods, Haryana

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brasss	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1537	0.1595	0.8463	0.8405	11.4	11.0	0.9
2	0.1396	0.1437	0.8602	0.8563	14.2	13.9	2.0
3	0.1466	0.1477	0.8534	0.8523	14.4	14.4	3.6
5	0.1557	0.1571	0.8443	0.8429	14.6	14.5	5.6
10	0.1651	0.1675	0.8349	0.8325	14.8	14.3	7.9
15	0.1810	0.1850	0.8190	0.8150	14.6	14.4	10.5
20	0.2062	0.2091	0.7938	0.7909	14.2	14.1	13.5

3.17 If the level of mortality is assumed to be the same as indicated by q (2) values, than the corresponding q(1), q(3) and q(5) values obtained from the West Model Life Tables are found to be 0.1127, 0.1508 and 0.1642 respectively in case of Brass method and 0.1161, 0.1566 and 0.1706 in case of Trussel method. These values provide estimates of infant mortality rate and child (0-4 years) mortality rate as 112.7 and 38.2 respectively in the former case and 116.1 and 39.9 in the latter case. These are quite close to the SRS estimates of 109 and 39.7, respectively for the year 1978.

(VI) HIMACHAL PRADESH

3.18 From table 43, it is observed that the q(1), l(1) values are considerably low for both Brass and Trussel methods. The q(1), l(1) values are generally affected by random fluctuations due to small number of events involved. The 'levels' in the West Model Life Tables corresponding to q(x), l(x) values are found to increase for successive values of x from age 2 years onwards. As higher 'level' corresponds to lower mortality, the successive q(x) values calculated by both the methods indicate progressively lower mortality which may be due to reporting errors affecting proportion of children dead on which the q(x) values are based. It is possible that the children dead are not as much reported as the children surviving. There may be a tendency to overlook such children while reporting the total number of children ever born. Also, there may be error due to recall lapse, which is likely to increase with the age of women as the time lag between the occurrence of event and its reporting increases. Moreover, the proportion of children dead is likely to increase with age of women and therefore, the extent of omission of such children is likely to be more in case of older women than in case of younger women.

TABLE 43

Mortality levels using Brass and Trussel methods, Himachal Pradesh

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trus-sel	
1	0.0796	0.0854	0.9204	0.9146	16.9	16.4	0.7
2	0.1306	0.1318	0.8694	0.8682	14.7	14.6	1.8
3	0.1136	0.1111	0.8864	0.8889	16.3	16.4	3.7
5	0.1106	0.1082	0.8894	0.8918	16.9	17.1	6.1
10	0.1189	0.1168	0.8811	0.8832	17.1	17.2	8.8
15	0.1105	0.1090	0.8895	0.8910	17.8	17.9	11.7
20	0.1112	0.1088	0.8888	0.8912	18.3	18.4	16.8

3·19 Assuming the 'level' of mortality to be the same as that corresponding to q(2) value, the values of q(1), q(3) and q(5) from the West Model Life Tables are found to be 0.1064, 0.1416 and 0.1540 respectively in case of Brass method and 0.1077, 0.1435 and 0.1561 respectively in case of Trussel method. These provide estimates of infant mortality rate as 106.4 by Brass method and 107·7 by Trussel method. The SRS estimate of infant mortality rate for 1978 is 101. The mortality rate for children aged 0-4 years is found to be 35.5 by Brass method and 36.1 by Trussel method. The SRS estimate for 1978 is 30.6.

(VII) JAMMU & KASHMIR

3.20 The estimates of q(x), l(x) by Brass method are close to those obtained by Trussel method as observed from table 44. Generally the q(1), l(1) values have been found to indicate higher mortality as compared to the rest of the q(x), l(x) values possibly because these are based on higher mortality experiences of children mostly of first birth order and born to young mothers.

TABLE 44

Mortality levels using Brass and Trussel methods, Jammu & Kashmir

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1068	0.1098	0.8932	0.8902	14.7	14.4	1.0
2	0.1182	0.1217	0.8818	0.8783	15.5	15.2	2.1
3	0.1256	0.1271	0.8744	0.8729	15.6	15.5	3.7
5	0.1333	0.1351	0.8667	0.8649	15.7	15.6	5.6
10	0.1584	0.1616	0.8416	0.8384	15.1	15.0	7.9
15	0.1703	0.1752	0.8297	0.8248	15.1	14.9	10.4
20	0.1861	0.1900	0.8139	0.8100	14.9	14.9	13.4

3.21 When the level of mortality is assumed to be the same as that indicated by the q(2) value and when the mortality pattern is assumed to be similar to that of West Model Life Tables two sets of estimates of infant and child mortality rates are obtained corresponding to Brass and Trussel methods. The estimates of q(1), q(3) and q(5) in the former case are 0.0965, 0.1273 and 0.1382 respectively which provide an infant mortality rate of 96.5 and child (0-4 years) mortality rate of 31.4. Similarly, the estimates of q(1), q(3) and q(5) in the latter case are 0.1002, 0.1326 and 0.1441, respectively which shows an infant mortality rate of 100.2. The child mortality rate works out to be 32.9 in this case. The estimates of infant mortality rate and child mortality rate from SRS for the year 1978 are 73 and 32.0, respectively. The estimate of infant mortality in the SRS seems to be under-reported.

(VIII) KARNATAKA

3.22 As has been generally observed, the q(x), l(x) values in respect of Karnataka presented in table 45 also show similarity in the estimates obtained by Brass and Trussel methods. The 'levels' corresponding to q(1) values indicate relatively much higher mortality as has generally been observed. The reasons for the same have been mentioned earlier. The 'levels' in respect of q(3) to q(15) are almost the same and are slightly higher than the 'levels' for q(2). The 'levels' corresponding to q(20) are found to be the highest. With increase in age of women, there is likely to be greater omission of number of children dead and as such the q(x) values calculated from proportions of children dead in respect of older age groups of women are likely to be on the lower side.

TABLE 45

Mortality levels using Brass and Trussel methods, Karnataka

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1175	0.1261	0.8805	0.8739	13.8	13.2	0.9
2	0.1168	0.1208	0.8832	0.8792	15.6	15.3	2.0
3	0.1181	0.1189	0.8819	0.8811	16.0	16.0	3.7
5	0.1242	0.1250	0.8758	0.8750	16.2	16.2	5.8
10	0.1348	0.1365	0.8652	0.8635	16.3	16.2	8.2
15	0.1479	0.1510	0.8521	0.8490	16.1	15.9	10.8
20	0.1468	0.1488	0.8532	0.8512	16.7	16.6	13.8

3.23 From table 45, it is observed that the 'levels' corresponding to q(2) values calculated by Brass and Trussel methods are 15.6 and 15.3 respectively. Corresponding to the 'level' 15.6, the values of q(1), q(3) and q(5) from the West Model Life Tables are 0.0953, 0.1255 and 0.1343 respectively. Thus the estimated infant mortality rate by Brass method is found to be 95.3. The corresponding mortality rate for children aged 0-4 years is found to be 30.9. Corresponding to 'level' 15.3, the values of q(1), q(3) and q(5) from the West Model Life Tables are 0.0989, 0.1308 and 0.1421 respectively. As such the mortality rates for infants and children aged 0-4 years by Trussel method are found to be 98.9 and 32.4 respectively. The corresponding estimates from SRS for the year 1978 are 82 and 35.5 respectively. The infant mortality rate from SRS appears to be under estimated.

(IX) KERALA

3.24 Unlike in the case of most of the other states, the 'levels' corresponding to q(x), l(x) values excepting q(1) and l(1) in respect of Kerala calculated by both Brass and Trussel methods indicate a declining trend in mortality. Thus it may be seen from table 46 that the levels corresponding to q(2) and successive q(x) values show a declining trend. As higher 'levels' indicate lower mortality and lower 'levels' indicate higher mortality, it is observed that the mortality in the recent past is relatively low as compared to the mortality in the more distant past. The q(1) values seem to be out of line with the rest of the values. It has already been mentioned that q(1) values are affected by random fluctuations and these are likely to be on the higher side being based on mortality experiences of children born to young mothers and mostly of first birth order.

TABLE 46

Mortality levels using Brass and Trussel methods, Kerala

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.0728	0.0759	0.9272	0.9241	17.5	17.2	0.9
2	0.0521	0.0576	0.9479	0.9424	19.7	19.6	2.0
3	0.0590	0.0592	0.9410	0.9408	19.7	19.7	3.6
5	0.0683	0.0687	0.9317	0.9313	19.4	19.4	5.7
10	0.0899	0.0910	0.9101	0.9090	18.1	18.1	8.0
15	0.1044	0.1063	0.8956	0.8937	18.0	18.0	10.6
20	0.1117	0.1128	0.8883	0.8872	18.2	18.2	13.6

3.25 Assuming the level of mortality to be the same as that indicated by q(2) value and the age pattern of mortality similar to that of West Model Life Tables, the estimates of infant and child mortality rates are obtained. In case of Brass method, the 'level' corresponding to q(2) value is 19.7. The values of q(1), q(3) and q(5) corresponding to this 'level' are found to be 0.0404,

0.0597 and 0.0642 respectively. These values provide estimates of infant mortality rate as 49.4 and child (0-4 years) mortality rate as 13.7. The 'level' corresponding to q(2) value calculated by Trussel method is found to be 19.6. The corresponding values of q(1), q(3) and q(5) in the West Model Life Tables are 0.0504, 0.0612 and 0.0658 respectively. These provide an estimate of infant mortality rate as 50.4 and an estimate of mortality rate for children aged 0-4 years as 14.0. The estimates for infant and child mortality rates from SRS are found to be 42 and 14.3 respectively for the year 1978. The estimates of infant mortality by Brass and Trussel methods are higher than those of SRS.

(X) MADHYA PRADESH

3.26 Table 47 shows mortality levels by Brass and Trussel methods alongwith the corresponding time reference periods. The 'levels' corresponding to q(1) values show very high mortality as has been generally observed in respect of other states. The possible reasons for this have been mentioned earlier.

TABLE 47

Mortality levels using Brass and Trussel methods, Madhya Pradesh

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1872	0.1991	0.8128	0.8009	9.3	8.7	1.0
2	0.1963	0.1967	0.8037	0.8033	11.2	11.2	2.4
3	0.1810	0.1770	0.8190	0.8230	12.7	12.9	4.4
5	0.1877	0.1846	0.8123	0.8154	13.2	13.3	6.7
10	0.2039	0.2020	0.7961	0.7980	13.2	13.3	9.3
15	0.2265	0.2267	0.7735	0.7733	12.8	12.8	12.1
20	0.2442	0.2429	0.7558	0.7571	12.8	12.8	15.0

3.27 It may be seen from table 31 that the 'levels' corresponding to q(2) values calculated by Brass and Trussel methods are the same. Corresponding to this 'level' of 11.2 the values of q(1), q(3) and q(5) in the West Model Life Tables are 0.1561, 0.2136 and 0.2336 respectively. These provide an estimate of infant mortality rate as 156.1 and an estimate of mortality rate for children in the age group 0-4 years as 58.1. These values can be compared with the corresponding SRS rates for 1978 which are found to be 143 and 63.8 respectively. Whereas the estimate of infant mortality rate from SRS is lower than the estimate by Brass and Trussel methods, the estimate of child mortality is higher in the former case than in the latter two cases. Possibly the age pattern of mortality during infancy and early childhood may not be similar to that of West Model Life Table system as assumed here.

(XI) MAHARASHTRA

3.28 Table 48 presents q(x), l(x) values calculated by Brass and Trussel methods alongwith the corresponding 'levels' in the West Model Life Tables. The q(1), l(1) values seem to be very much out of line with the rest of the q(x), l(x) values all of which correspond to 'levels' of almost the same order. The q(1) values indicate higher mortality as has been observed in respect of most of the other states, for which the possible reasons have been indicated earlier.

TABLE 48

Mortality levels using Brass and Trussel methods, Maharashtra

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1388	0.1476	0.8612	0.8524	12.3	11.7	0.9
2	0.1146	0.1165	0.8854	0.8835	15.7	15.6	2.1
3	0.1083	0.1074	0.8917	0.8929	16.6	16.6	4.0
5	0.1221	0.1212	0.8779	0.8788	16.3	16.4	6.3
10	0.1351	0.1350	0.8649	0.8650	16.3	16.3	8.9
15	0.1427	0.1437	0.8573	0.8563	16.3	16.3	11.6
20	0.1655	0.1654	0.8345	0.8346	15.9	15.9	14.6

3.29 Corresponding to 'level' 15.7 for q(2) as shown in table 48; the values of q(1), q(3) and q(5) from West Model Life Tables are found to be 0.0940, 0.1237 and 0.1344 respectively. Thus the estimated infant mortality rate in case of Brass method is 94.0. The corresponding mortality rate for age group 0-4 years works out to be 30.4. In case of Trussel method the 'level' corresponding to q(2) is 15.6 (table 48). The values of q(1), q(3) and q(5) corresponding to this 'level' are 0.0953, 0.1255 and 0.1363 respectively. These provide estimates of infant and child (0-4 years) mortality rates as 95.3 and 30.9 respectively. The corresponding SRS estimates are found to be 81 and 32.8 respectively for the year 1978. Thus, while the infant mortality rates in case of Brass and Trussel methods are found to be higher than the SRS estimates, the child mortality rates calculated by the two methods are found to be lower than the SRS rate. Possibly, the age pattern of mortality during infancy and early childhood does not conform to West Model Life Table System as assumed here for calculating the infant and child mortality rates in respect of Brass and Trussel methods.

(XII) ORISSA

3.30 The estimates of q(x), l(x) calculated by Brass and Trussel methods are shown in table 49. The table also shows the corresponding 'levels' in the West Model Life Tables and the time reference period in terms of the number of years prior

to the survey to which these relate. As has been generally observed earlier, the 'levels' corresponding to q(1) values are found to represent relatively high mortality, the 'levels' corresponding to q(2) values represent slightly lower mortality and the subsequent 'levels' which are more or less constant represent still lower mortality. Possibly q(3) and successive q(x) values are on the lower side due to reporting errors resulting in lower proportions of children dead in respect of higher age groups of women on which these q(x) values are based. The q(1) value is generally affected by random fluctuations due to small number of events and is likely to be on the higher side as this is based on the mortality experiences of children born to young mothers and mostly of first birth order.

TABLE 49

Mortality levels using Brass and Trussel methods, Orissa

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to) the survey
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1907	0.2028	0.8093	0.7972	9.1	8.5	0.9
2	0.1352	0.1335	0.8148	0.8115	11.8	11.6	2.0
3	0.1749	0.1734	0.8251	0.8266	13.0	13.1	3.8
5	0.1876	0.1863	0.8124	0.8137	13.2	13.2	6.1
10	0.1980	0.1977	0.8020	0.8023	13.4	13.4	8.6
15	0.2174	0.2187	0.7926	0.7813	13.1	13.1	11.3
20	0.2322	0.2319	0.7678	0.7681	13.2	13.2	14.3

3.31 Assuming the 'level' corresponding to q(2) values as representing the mortality level during infancy and early childhood and the age pattern of mortality during infancy and early childhood to correspond that of West Model Life Table System, the q(1), q(3) and q(5) values corresponding to 'level' 11.8 in respect of q(2) value calculated by Brass method are found to be 0.1469, 0.2008 and 0.2194 respectively. These provide an estimate of infant mortality rate as 146.9 and an estimate of mortality rate for children aged 0-4 years as 53.8. The 'level' in respect of q(2) value calculated by Trussel method is found to be 11.6. The corresponding values of q(1), q(3) and q(5) from the West Model Life Tables are found to be 0.1500, 0.2050 and 0.2241 respectively. The infant mortality rate thus estimated is 150.0 and the child (0-4 years) mortality rate works out to be 55.2. The SRS estimates for the year 1978 are 133 for infant mortality rate and 45.9 for child (0-4 years) mortality rate. Thus the rates calculated by Brass as well as Trussel methods are found to be higher than the SRS rates.

(XIII) PUNJAB

3.32 The q(x), l(x) values calculated by Brass and Trussel methods alongwith the corresponding 'levels' in the West Model Life Table System are presented in table 50. Successive 'levels' are found to indicate progressively lower mortality. This may be due to reporting errors resulting in progressively lower proportions of children dead among children ever born in respect of women in successive higher age groups. Possibility of omission of dead children is likely to be more with increase in age of women as the time lag between the occurrence of such event and its reporting increases.

TABLE 50

Mortality levels using Brass and Trussel methods, Punjab

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1605	0.1595	0.8395	0.8405	10.9	10.9	0.8
2	0.1198	0.1226	0.8802	0.8774	15.4	15.2	1.6
3	0.1106	0.1117	0.8894	0.8883	16.2	16.4	3.1
5	0.1148	0.1160	0.8852	0.8040	16.7	16.7	4.9
10	0.1187	0.1204	0.8813	0.8796	17.1	16.9	7.0
15	0.1183	0.1205	0.8817	0.8795	17.5	17.3	9.5
20	0.1335	0.1346	0.8665	0.8654	17.3	17.2	12.6

3.33 For estimating mortality during infancy and early childhood, the mortality level may be assumed to be the same as that corresponding to q(2) value and the age pattern of mortality may be considered similar to that of the West Model Life Table System. The q(2) value calculated by Brass method is found to correspond to the 'level' 15.4 in the West Model Life Table System. The values of q(1), q(3) and q(5) corresponding to this 'level' are found to be 0.1062, 0.1378 and 0.1489 respectively. Thus the estimate of infant mortality rate is found to be 106.2 and the estimate of mortality rate for early childhood works out to be 34.2. The q(2) value calculated by Trussel method corresponds to the 'level' 15.2. The values of q(1), q(3) and q(5) corresponding to this 'level' are 0.1088, 0.1414 and 0.1528 respectively. These indicate an infant mortality rate of 108.8 and provide an estimate of mortality rate during early childhood as 35.3. A comparison with the corresponding SRS estimates for 1978 indicate that the infant mortality rates calculated by Brass and Trussel methods are closer to SRS estimate of 117. The child mortality rates calculated by the two methods are lower than the SRS rate of 40.8. It may be possible that the age pattern of mortality during infancy and early childhood may not be similar to that of the West Model Life Tables as has been assumed in the present case.

(XIV) RAJASTHAN

3.34 The 'levels' corresponding to successive q(x), l(x) values are presented in table 51. The 'levels' increase with age possibly due to reporting errors affecting the proportion of dead children on which the q(x) values are based. The omission of dead children is likely to be more with increase in age of women as the time lag between the occurrence of the event and its reporting increases. It may also be seen from table 51 that the 'levels' corresponding to q(1) values are considerably different from the 'levels' corresponding to the rest of the q(x) values. These indicate considerably higher mortality as compared to the rest of the q(x) values. Possibly the q(1) values are on the higher side as has been generally observed and for which the possible reasons have been mentioned earlier. The q(1) values are also affected by random fluctuations due to small number of events involved.

TABLE 51

Mortality levels using Brass and Trussel methods, Rajasthan

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1558	0.1671	0.8442	0.8329	11.2	10.5	0.9
2	0.1600	0.1619	0.8400	0.8381	13.0	13.0	2.2
3	0.1625	0.1602	0.8375	0.8398	13.6	13.7	4.1
5	0.1737	0.1715	0.8263	0.8285	13.8	13.8	6.5
10	0.1759	0.1743	0.8241	0.8252	14.3	14.4	9.2
15	0.1838	0.1842	0.8162	0.8158	14.5	14.4	12.0
20	0.1958	0.1950	0.8042	0.8050	14.6	14.6	15.0

3.35 In order to estimate mortality during infancy and early childhood, the level of mortality is generally assumed to be the same as that corresponding to q(2) value and the age pattern of mortality similar to that of West Model Life Table System. Table 51 shows that the q(2) values calculated by Brass and Trussel methods correspond to the same 'level' 13.0 in the West Model Life Table System. For this 'level' the values of q(1), q(3) and q(5) are found to be 0.1291, 0.1751 and 0.1912 respectively. Thus the infant mortality rate comes out to be 129.1 and the child (0-4 years) mortality rate works out to be 45.6 which are found to be quite lower than the SRS estimates of 140 and 63.3 respectively for the year 1978. The q(2) values appear to be on the lower side.

(XV) TAMIL NADU

3.36 Table 52 shows that the 'levels' corresponding to all the q(x) values except q(1) are almost the same whether calculated by Brass or Trussel method. The 'levels' corresponding to q(1) values represent higher mortality. These are based on proportion of children dead among those ever born in respect of women in the age group 15-19 years. Most of the children may be of first birth order which in relation to low age at maternity may tend to inflate the mortality experienced by them. As the rest of the q(x) values correspond to approximately the same level there is apparently no indication of any decline in mortality.

TABLE 52

Mortality levels using Brass and Trussel methods, Tamil Nadu

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.1287	0.1366	0.8713	0.8634	13.0	12.5	0.9
2	0.1317	0.1342	0.8883	0.8658	14.6	14.5	2.1
3	0.1463	0.1453	0.8537	0.8547	14.4	14.5	3.9
5	0.1541	0.1534	0.8459	0.8466	14.7	14.7	6.1
10	0.1724	0.1726	0.8276	0.8274	14.5	14.5	8.7
15	0.1816	0.1832	0.8184	0.8168	14.6	14.5	11.4
20	0.1967	0.1970	0.8033	0.8030	14.6	14.6	14.4

3.37 For estimating mortality during infancy and early childhood the level of mortality is considered to be the same as that indicated by q(2) value. According to Brass method the q(2) value corresponds to 'level' 14.6 in the West Model Life Table System. The corresponding q(1), q(3) and q(5) values from the same Life Table System are 0.1224, 0.1773 and 0.1917 respectively. The 'level' corresponding to q(2) value calculated by Trussel method is 14.5. The corresponding q(1), q(3) and q(5) values from the West Model Life Table System are 0.1234, 0.1791 and 0.1936 respectively. Thus the estimates of mortality rates during infancy and early childhood (0-4 years) are found to be 122.4 and 45.6 respectively in case of Brass method and 123.4 and 46.2 respectively in case of Trussel method. The corresponding SRS estimates are found to be 105 and 40.8 respectively for the year 1978.

(XVI) UTTAR PRADESH

3.38 Table 53 shows mortality levels using Brass and Trussel methods. The table also shows time reference period in terms of the number of years prior to the survey to which each of the q(x), l(x) values and the corresponding 'levels' relate. As generally observed, the 'levels' corresponding to q(1) values indicate very high mortality for which the possible reasons have been indicated earlier. The 'levels' corresponding to the q(x) values show an increasing trend indicating progressively low mortality. This may be due to reporting errors in the number of children dead on which the estimates are based.

TABLE 53

Mortality levels using Brass and Trussel methods, Uttar Pradesh

Age (x)	q(x)		l(x)		Level (West Model)		Time reference period (years prior to the survey)
	Brass	Trussel	Brass	Trussel	Brass	Trussel	
1	0.2075	0.2193	0.7925	0.7807	8.2	7.6	1.0
2	0.2080	0.2125	0.7920	0.7875	10.6	10.4	2.2
3	0.1944	0.1934	0.8056	0.8066	12.1	12.1	3.9
5	0.1958	0.1953	0.8042	0.8047	12.8	12.8	6.0
10	0.2074	0.2082	0.7926	0.7918	13.0	12.9	8.4
15	0.2129	0.2155	0.7871	0.7845	13.1	13.2	11.0
20	0.2295	0.2300	0.7705	0.7700	13.3	13.3	14.0

3.39 Assuming the level of mortality to be the same as that represented by q(2) value and assuming that the age pattern of mortality is similar to that of West Model Life Table System, the estimates of infant and child mortality rates are worked out. In case of Brass method, the q(2) value corresponds to a 'level' 10.6 for which the corresponding q(1), q(3) and q(5) values from the West Model Life Table System are 0.1629, 0.2540 and 0.2780 respectively. These values provide estimate of infant mortality rate as 162.9 and estimate of child mortality rate as 71.6. Corresponding to q(2) value calculated by Trussel method, the 'level' in the West Model Life Table System is 10.4. The corresponding q(1), q(3) and q(5) values are found to be 0.1650, 0.2582 and 0.2827 respectively which show infant mortality rate of 165.0. The child mortality rate in this case works out to be 73.2. These estimates are lower than the corresponding SRS estimates of 177 and 81.0 respectively for the year 1978.

Chapter 4

SRS BASED ADJUSTED ESTIMATES OF BIRTH AND DEATH RATES, 1971-80

4.1 An attempt has been made here to estimate the birth and death rate at the national level for each year during the inter-censal period 1971-80, by making use of the adjusted SRS rates derived from indirect methods. An evaluation of the death registration completeness in the sample registration system (SRS) was done using Brass technique for the period 1970-75, the details of which are incorporated in the report on Sample Registration System 1970-75. The results reveal that the under-reporting of births and deaths during 1970-75 is 6 per cent at the national level. It is estimated that the birth rate and death rate are 38.0 and 16.5 respectively for the period 1970-75, centred around January, 1973.

4.2 The application of P/F method as described in Chapter 2 indicates that the estimated birth rate at the national level is 34.1 for the calendar year 1978. The SRS estimate during the same period is 33.3 Thus, the extent of under-reporting of births in the SRS for the year 1978 is about 2.5 per cent. During the first half of the decade 1971-80, the extent of omission of events in the SRS was more than that of the latter half on account of various reasons which are given below :—

(i) SRS was in the initial stages of implementation.

(ii) The field work during 1973 and 1974 was seriously affected on account of financial constraints.

(iii) A vigorous family planning compaign was in existence which would have tended to affect the reporting of births and subsequent infant deaths.

4.3 Taking into account the omission of 6 per cent in case of both births and deaths during 1970-75, the adjusted birth and death rates for the period are 38.0 and 16.5 respectively which are centred around January 1973. The extent of omission of births during 1978 has been found to be about 2.5 per cent. The adjusted birth rate is accordingly 34.1. If the omission of deaths is also of the same order, the adjusted death rate for 1978 would be 14.5. There has been progressive improvement in the reporting of births and deaths. Even assuming the extent of under-reporting of births and deaths in 1980 to be the same as in 1978, the adjusted birth and death rates for 1980 would be 34.1 and 12.8 respectively . By fitting a second degree curve to each of the sets of adjusted birth and death rates, a series of birth and death rates for each year of the inter-censal period 1971-80 is obtained. These rates are given below :

	1971	1972	1973	1974	1975	1976
Birth Rate	40.0	38.6	37.4	36.4	35.5	34.9
Death Rate	16.5	16.5	16.5	16.4	16.1	15.7

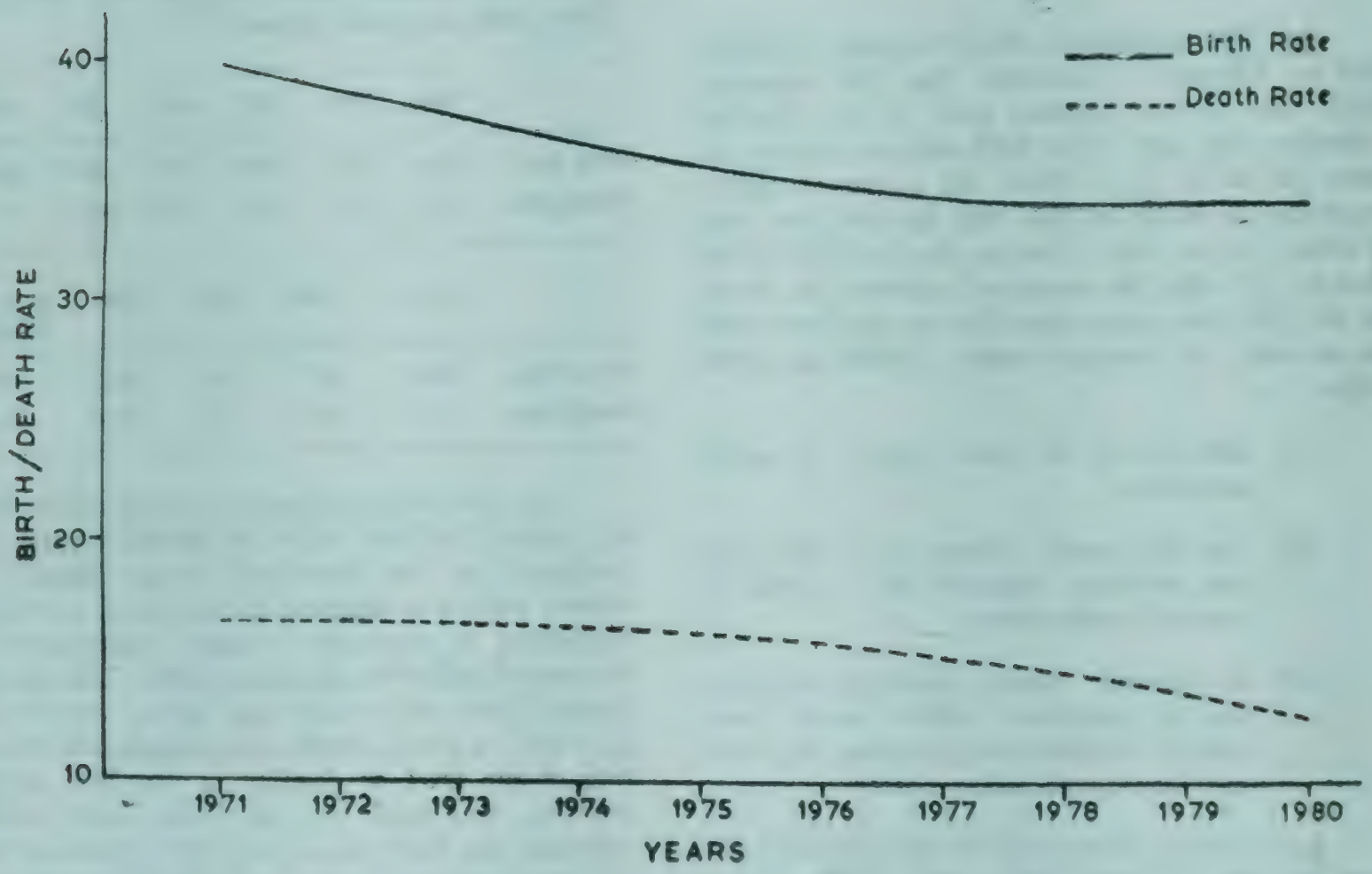
	1977	1978	1979	1980	1971-80 (Avg.)
Birth Rate	34.4	34.1	34.1	34.1	36.0
Death Rate	15.2	14.5	13.7	12.8	15.4

4.4 It is seen that there is a sharp fall in fertility during the first half of the decade 1971-80 as compared to the latter half of the decade. A reverse pattern is observed in the case of mortality. Reduction in mortality is more conspicuous in the second half of the decade 1971-80. The average decadal birth and death rates during 1971-80 are 36.0 and 15.4 respectively. An independent evaluation of the level of fertility in the SRS during 1970-72 was made by the India Panel which estimated the birth rate during 1970-72 around 40. The result obtained from the quadratic function also gives the same birth rate during 1970-72.

4.5 The computed birth and death rates foreach year of the decade 1971-80 are shown in chart 35.

CHART-35

SRS BASED ADJUSTED ANNUAL BIRTH AND DEATH RATES DURING THE DECADE 1971-80, INDIA



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